INTERNATIONAL STANDARD

ISO/IEC 5965

Second edition
2023-05

Information technology — Swordfish Scalable Storage Management API Specification

Reference number
ISO/IEC 5965:2023(E)

Documents
Document Sharing Hub

© ISO/IEC 2023

Full document details: ISO_IEC 5965_2023

COPYRIGHT PROTECTED DOCUMENT

© ISO/IEC 2023

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

© ISO/IEC 2023 – All rights reserved

Documents
Document Sharing Hub

Full document details: ISO_IEC 5965_2023

Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of document should be noted (see www.iso.org/directives or www.iec.ch/members_experts/refdocs).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents) or the IEC list of patent declarations received (see https://patents.iec.ch).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html. In the IEC, see www.iec.ch/understanding-standards.

This document was prepared by SNIA (as Swordfish Scalable Storage Management API Specification, Version, 1.2.4a) and drafted in accordance with its editorial rules. It was adopted, under the JTC 1 PAS procedure, by Joint Technical Committee ISO/IEC JTC 1, *Information technology*.

This second edition cancels and replaces the first edition (ISO/IEC 5965:2021), which has been technically revised.

The main changes are as follows:

— document has been aligned with DMTF's Redfish Forum 2021.1 release of the Redfish Specification, schema bundle, and other supporting materials;

— support for NVMe and NVMe-oF has been added, expanding the API to support the management of NVMe and NVMe-oF devices and systems;

— the Swordfish Standalone Configuration has been added in the /Storage collection at the ServiceRoot. This simplification of the hierarchy features Storage systems at the ServiceRoot and makes standalone implementations easier to instrument;

— substantial schema changes have been made, including:

  — enhancements to Volume, including new Actions (e.g., ChangeRAIDLayout, ForceEnable); addition of InitializeMethod, IOPerfModeEnabled, and OwningStorageResource and link to JournalingMedia; added InitializeMethod property; added IsBootCapable,

© ISO/IEC 2023 – All rights reserved

Documents
Document Sharing Hub
Full document details: ISO_IEC 5965_2023

  - enhancements to StoragePools,
  - addition of NVMeDomain schema, and Split NVMeFirmwareImage and NVMeDomains schemas,
  - deprecation of use of NetworkPort; replacement with Port;
- security has been improved, including:
  - new requirements added to NVMeDrive to conform to schema updates for SecureErase,
  - enhancement of CHAP definitions and usage in StorageGroup;
- Profiles have been expanded, including:
  - addition of new profiles for Access Rights management, Connectivity Rights management, Management Controllers, NVMe EBOF, PCIe JBOF, and NVMe-oF,
  - movement of Swordfish profiles to SwordfishInteroperabilityProfile as base – extends Redfish Interoperability Profile, adding support for "conditionals" and comparison for Required Profiles,
  - update of FeaturesRegistry to v1.3.0 to correspond to latest versions of all profiles,
  - updates in multiple profiles to correct conformance to interoperability schema. Modifications to support change for new RequiredProfiles conditionals support.
  - addition of new profile for Swordfish NVMe Front End (used by complex devices such as arrays),
  - enhancement of profiles to include support / requirements for /Storage (move support to v1.1.0 level),
  - addition of NVMe drive, Advanced Features and Ethernet Attach profiles,
  - enhancement of Swordfish event profile,
  - addition of SupportedPoolTypes to StoragePool Profiles.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html and www.iec.ch/national-committees.

© ISO/IEC 2023 – All rights reserved
Documents
Document Sharing Hub
Full document details: ISO_IEC 5965_2023

Documents
Document Sharing Hub

Full document details: ISO_IEC 5965_2023

Contents

USAGE . . . 12
DISCLAIMER . . . 13
Current Revision . . . 13
Contact SNIA . . . 13
FEEDBACK AND INTERPRETATIONS . . . 13
INTENDED AUDIENCE . . . 14
VERSIONING POLICY . . . 14
Revision History . . . 14
About SNIA . . . 20
Acknowledgements . . . 20

1 Abstract 23

2 Scope 24
2.1 Document Goals . . . 24
2.2 Audience Assumptions . . . 25

3 Normative References 26
3.1 Overview . . . 26
3.2 Approved references . . . 26
3.3 References under development . . . 28
3.4 Other references . . . 28

4 Terms and Definitions 29
4.1 Overview . . . 29
4.2 Swordfish-specific Terms . . . 29
4.2.1 Definitions . . . 29
4.2.2 Symbols and abbreviated terms . . . 30
4.3 Reference to Redfish terms . . . 30
4.4 Keywords (normative language terms) . . . 30

5 Swordfish Overview 32
5.1 Introduction . . . 32
5.2 Relation to Redfish . . . 32
5.3 Storage System Models . . . 33
5.4 The ServiceRoot and ServiceContainer entities . . . 37
5.4.1 Overview . . . 37
5.4.2 The Storage resource collection . . . 37

Documents
Document Sharing Hub
© ISO/IEC 2023 – All rights reserved
Full document details: ISO_IEC 5965_2023

5.4.3 The Systems resource collection 38
5.4.4 The Chassis resource collection 38
5.4.5 The StorageSystems resource collection 38
5.5 Swordfish model overview 39
5.5.1 The Storage resource 39
5.5.2 The StorageController resource 40
5.5.3 The Endpoint resource 40
5.5.4 The Endpoint Collection resource 40
5.5.5 The ConsistencyGroup resource 40
5.5.6 The ConsistencyGroup Collection resource 40
5.5.7 The StorageGroup resource 40
5.5.8 The StoragePool resource 41
5.5.9 The Volume resource 41
5.5.10 The FileSystem resource 42

6 Features and Profiles 43
6.1 Overview 43
6.2 Requirement for SupportedFeatures 43
6.3 EnergyStar for Storage Feature 44
6.4 Class of Service Feature 44
6.4.1 Overview 44
6.4.2 Class of Service Model 44
6.4.3 ServiceRoot Additions 49
6.4.4 The StorageService resource 49

7 Schema Considerations 53
7.1 Schema Introduction 53
7.1.1 Overview 53
7.1.2 Swordfish Extension of the Redfish ServiceRoot 53
7.2 Default values and NULLABLE attributes 53
7.3 Common schema annotations 54
7.4 Property implementation requirements 56
7.5 Schema repository 56
7.6 Referencing other schemas 56

8 Implementation requirements 57
8.1 Security 57
8.2 General constraints 57
8.2.1 Redfish elements 57

© ISO/IEC 2023 – All rights reserved

Documents
Document Sharing Hub

Full document details: ISO_IEC 5965_2023

8.2.2 Storage Events . . . 57
8.3 Discovering Swordfish resources . . . 58
8.4 ClassOfService requirements . . . 59
8.5 StorageSystems requirements . . . 59
8.6 Entity Sets . . . 60
8.7 Addressing entities within a collection . . . 60
8.8 Addressing members of a ResourceCollection . . . 60
8.9 HTTP status codes . . . 61
8.9.1 Overview . . . 61
8.9.2 Create . . . 61
8.9.3 Update, Replace, Delete . . . 62
8.9.4 Actions . . . 63

9 Swordfish type definitions 65
9.1 Overview . . . 65
9.2 Introduction . . . 65
9.3 Universal properties . . . 65
9.4 Frequently used properties . . . 67
9.5 Common Swordfish Objects . . . 69
9.5.1 Capacity . . . 69
9.5.2 CapacityInfo . . . 70
9.5.3 Identifier . . . 71
9.5.4 IOStatistics . . . 74
9.5.5 IOWorkload . . . 77
9.5.6 IOWorkloadComponent . . . 78
9.5.7 Location . . . 80
9.5.8 Oem . . . 97
9.5.9 ReplicaInfo . . . 97
9.5.10 ReplicaRequest . . . 119
9.5.11 Schedule . . . 120
9.5.12 Status . . . 125
9.6 Swordfish Schema Types . . . 133
9.6.1 CapacitySource 1.2.0 . . . 133
9.6.2 CapacitySourceCollection . . . 138
9.6.3 ClassOfService 1.2.0 . . . 140
9.6.4 ClassOfServiceCollection . . . 145
9.6.5 ConsistencyGroup 1.1.0 . . . 147
9.6.6 ConsistencyGroupCollection . . . 163
9.6.7 DataProtectionLineOfService 1.3.0 . . . 165

Documents
Document Sharing Hub
© ISO/IEC 2023 – All rights reserved
Full document details: ISO_IEC 5965_2023

9.6.8 DataProtectionLoSCapabilities 1.2.0 174
9.6.9 DataSecurityLineOfService 1.1.1 182
9.6.10 DataSecurityLoSCapabilities 1.2.0 190
9.6.11 DataStorageLineOfService 1.3.1 199
9.6.12 DataStorageLoSCapabilities 1.2.2 205
9.6.13 FeaturesRegistry 1.1.1 211
9.6.14 FileShare 1.2.0 214
9.6.15 FileShareCollection 225
9.6.16 FileSystem 1.2.2 227
9.6.17 FileSystemCollection 239
9.6.18 HostedStorageServices 241
9.6.19 IOConnectivityLineOfService 1.2.1 243
9.6.20 IOConnectivityLoSCapabilities 1.2.0 250
9.6.21 IOPerformanceLineOfService 1.1.1 256
9.6.22 IOPerformanceLoSCapabilities 1.3.0 260
9.6.23 LineOfService 1.1.0 263
9.6.24 LineOfServiceCollection 265
9.6.25 NVMeDomain 1.1.0 267
9.6.26 NVMeDomainCollection 271
9.6.27 NVMeFirmwareImage 1.1.0 273
9.6.28 SpareResourceSet 1.0.1 276
9.6.29 StorageGroup 1.5.0 280
9.6.30 StorageGroupCollection 296
9.6.31 StoragePool 1.7.1 298
9.6.32 StoragePoolCollection 335
9.6.33 StorageReplicaInfo 1.4.0 338
9.6.34 StorageService 1.5.0 340
9.6.35 StorageServiceCollection 355
9.6.36 StorageSystemCollection 357
9.6.37 Volume 1.8.0 359
9.6.38 VolumeCollection 410

Annex A: Bibliography **413**
A.1 Overview 413
A.2 Informational references 413

© ISO/IEC 2023 – All rights reserved

Documents
Document Sharing Hub

Full document details: ISO_IEC 5965_2023

List of Tables

1 Revision history 15
2 Contributors 21
3 Approved normative references 26
4 References under development 28
5 Swordfish terms 29
6 Redfish terms 30
7 Normative language terms 31
8 Default and Nullable Interaction 54
9 Schema annotations 54
10 Universal properties 65
11 Frequent properties 67
12 Capacity properties 69
13 CapacityInfo properties 70
14 Identifier properties 72
15 DurableNameFormat property values 73
16 IOStatistics properties 75
17 IOWorkload properties 77
18 IOWorkloadComponent properties 78
19 IOAccessPattern property values 80
20 Location properties 81
21 LocationType property values 95
22 Orientation property values 95
23 RackOffsetUnits property values 96
24 Reference property values 96
25 Oem properties 97
26 ReplicaInfo properties 98
27 ConsistencyState property values 109
28 ConsistencyStatus property values 109
29 ConsistencyType property values 110
30 ReplicaFaultDomain property values 110
31 ReplicaPriority property values 110
32 ReplicaProgressStatus property values 111
33 ReplicaReadOnlyAccess property values 113
34 ReplicaRecoveryMode property values 113
35 ReplicaRole property values 114
36 ReplicaState property values 114

Documents
Document Sharing Hub
© ISO/IEC 2023 – All rights reserved
Full document details: ISO_IEC 5965_2023

37 ReplicaType property values 116
38 ReplicaUpdateMode property values 117
39 RequestedReplicaState property values 117
40 UndiscoveredElement property values 119
41 ReplicaRequest properties 120
42 Schedule properties 121
43 EnabledDaysOfWeek property values 123
44 EnabledMonthsOfYear property values 124
45 Status properties 125
46 Health property values 131
47 HealthRollup property values 131
48 Severity property values 131
49 State property values 132
50 CapacitySource 1.2.0 properties 134
51 CapacitySourceCollection properties 139
52 ClassOfService 1.2.0 properties 141
53 ClassOfServiceCollection properties 145
54 ConsistencyGroup 1.1.0 properties 148
55 AssignReplicaTarget action parameters 156
56 CreateReplicaTarget action parameters 157
57 RemoveReplicaRelationship action parameters 158
58 ResumeReplication action parameters 159
59 ReverseReplicationRelationship action parameters 160
60 SplitReplication action parameters 160
61 SuspendReplication action parameters 161
62 ConsistencyMethod property values 161
63 ConsistencyType property values 162
64 ReplicaType property values 162
65 ReplicaUpdateMode property values 163
66 ConsistencyGroupCollection properties 164
67 DataProtectionLineOfService 1.3.0 properties 166
68 CreateReplicas action parameters 171
69 RecoveryGeographicObjective property values 172
70 RecoveryTimeObjective property values 173
71 ReplicaType property values 174
72 DataProtectionLoSCapabilities 1.2.0 properties 174
73 SupportedRecoveryGeographicObjectives property values 180
74 SupportedRecoveryTimeObjectives property values 181

© ISO/IEC 2023 – All rights reserved

Documents
Document Sharing Hub

Full document details: ISO_IEC 5965_2023

75 SupportedReplicaTypes property values 181
76 DataSecurityLineOfService 1.1.1 properties 182
77 AntivirusScanPolicies property values 186
78 ChannelEncryptionStrength property values 187
79 DataSanitizationPolicy property values 187
80 HostAuthenticationType property values 188
81 MediaEncryptionStrength property values 188
82 SecureChannelProtocol property values 189
83 UserAuthenticationType property values 189
84 DataSecurityLoSCapabilities 1.2.0 properties 191
85 SupportedAntivirusScanPolicies property values 195
86 SupportedChannelEncryptionStrengths property values 196
87 SupportedDataSanitizationPolicies property values 196
88 SupportedHostAuthenticationTypes property values 197
89 SupportedMediaEncryptionStrengths property values 198
90 SupportedSecureChannelProtocols property values 198
91 SupportedUserAuthenticationTypes property values 199
92 DataStorageLineOfService 1.3.1 properties 200
93 AccessCapabilities property values 203
94 ProvisioningPolicy property values 204
95 RecoveryTimeObjectives property values 205
96 DataStorageLoSCapabilities 1.2.2 properties 206
97 SupportedAccessCapabilities property values 209
98 SupportedProvisioningPolicies property values 210
99 SupportedRecoveryTimeObjectives property values 210
100 FeaturesRegistry 1.1.1 properties 211
101 FileShare 1.2.0 properties 214
102 DefaultAccessCapabilities property values 223
103 FileShareQuotaType property values 224
104 FileSharingProtocols property values 224
105 WritePolicy property values 225
106 FileShareCollection properties 226
107 FileSystem 1.2.2 properties 228
108 AccessCapabilities property values 238
109 CharacterCodeSet property values 238
110 FileSystemCollection properties 239
111 HostedStorageServices properties 241
112 IOConnectivityLineOfService 1.2.1 properties 244

Documents
Document Sharing Hub
© ISO/IEC 2023 – All rights reserved
Full document details: ISO_IEC 5965_2023

113 AccessProtocols property values 246
114 IOConnectivityLoSCapabilities 1.2.0 properties 250
115 SupportedAccessProtocols property values 253
116 IOPerformanceLineOfService 1.1.1 properties 257
117 IOPerformanceLoSCapabilities 1.3.0 properties 260
118 LineOfService 1.1.0 properties 264
119 LineOfServiceCollection properties 266
120 NVMeDomain 1.1.0 properties 268
121 NVMeDomainCollection properties 272
122 NVMeFirmwareImage 1.1.0 properties 274
123 NVMeDeviceType property values 276
124 SpareResourceSet 1.0.1 properties 276
125 StorageGroup 1.5.0 properties 281
126 AccessCapability property values 294
127 AccessState property values 295
128 AuthenticationMethod property values 295
129 StorageGroupCollection properties 296
130 StoragePool 1.7.1 properties 299
131 AddDrives action parameters 326
132 RemoveDrives action parameters 328
133 SetCompressionState action parameters 329
134 SetDeduplicationState action parameters 329
135 SetEncryptionState action parameters 330
136 NVMePoolType property values 330
137 PoolType property values 331
138 SupportedPoolTypes property values 331
139 SupportedProvisioningPolicies property values 332
140 SupportedRAIDTypes property values 332
141 StoragePoolCollection properties 336
142 StorageReplicaInfo 1.4.0 properties 338
143 StorageService 1.5.0 properties 340
144 SetEncryptionKey action parameters 354
146 StorageServiceCollection properties 355
147 StorageSystemCollection properties 357
148 Volume 1.8.0 properties 360
149 AssignReplicaTarget action parameters 391
150 ChangeRAIDLayout action parameters 392
151 CreateReplicaTarget action parameters 394

© ISO/IEC 2023 – All rights reserved

Documents
Document Sharing Hub

Full document details: ISO_IEC 5965_2023

152 Initialize action parameters 395
153 RemoveReplicaRelationship action parameters 396
154 ResumeReplication action parameters 397
155 ReverseReplicationRelationship action parameters 398
156 SplitReplication action parameters 398
157 SuspendReplication action parameters 399
158 AccessCapabilities property values 399
159 EncryptionTypes property values 400
160 InitializeMethod property values 400
161 InitializeType property values 401
162 LBAFormatsSupported property values 401
163 ProvisioningPolicy property values 402
164 RAIDType property values 402
165 ReadCachePolicy property values 406
166 ReplicaType property values 406
167 ReplicaUpdateMode property values 407
168 VolumeType property values 407
169 VolumeUsage property values 408
170 WriteCachePolicy property values 408
171 WriteCacheState property values 409
172 WriteHoleProtectionPolicy property values 409
173 VolumeCollection properties 411

Documents
Document Sharing Hub
© ISO/IEC 2023 – All rights reserved
Full document details: ISO_IEC 5965_2023

List of Figures

1 Model Overview 32
2 Logical Subsystem in Swordfish Standalone Configuration 34
3 Swordfish Standalone Configuration Example 35
4 Logical Subsystem in Swordfish Integrated Configuration 36
5 Swordfish Integrated Configuration Example 37
6 Logical Subsystem in Integrated Service Configuration 45
7 Integrated Service Configuration Example 46
8 Logical Subsystem in Standalone Service Configuration 47
9 Standalone Service Configuration Example 48

© ISO/IEC 2023 – All rights reserved

Documents
Document Sharing Hub

Full document details: ISO_IEC 5965_2023

USAGE

Copyright (c) 2016 - 2022 SNIA. All rights reserved. All other trademarks or registered trademarks are the property of their respective owners.

The SNIA hereby grants permission for individuals to use this document for personal use only, and for corporations and other business entities to use this document for internal use only (including internal copying, distribution, and display) provided that:

1. Any text, diagram, chart, table or definition reproduced must be reproduced in its entirety with no alteration, and,
2. Any document, printed or electronic, in which material from this document (or any portion hereof) is reproduced must acknowledge the SNIA copyright on that material, and must credit the SNIA for granting permission for its reuse.

Other than as explicitly provided above, you may not make any commercial use of this document, or any portion thereof, or distribute this document to third parties. All rights not explicitly granted are expressly reserved to SNIA.

Permission to use this document for purposes other than those enumerated above may be requested by emailing tcmd@snia.org. Please include the identity of the requesting individual and/or company and a brief description of the purpose, nature, and scope of the requested use.

All code fragments, scripts, data tables, and sample code in this SNIA document are made available under the following license:

BSD 3-Clause Software License

Copyright (c) 2022, The Storage Networking Industry Association.

Redistribution and use in source and binary forms, with or without modification, are permitted provided that the following conditions are met:

- Redistributions of source code must retain the above copyright notice, this list of conditions and the following disclaimer.
- Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.
- Neither the name of The Storage Networking Industry Association (SNIA) nor the names of its contributors may be used to endorse or promote products derived from this software without specific prior written permission.

Documents
Document Sharing Hub
© ISO/IEC 2023 – All rights reserved
Full document details: ISO_IEC 5965_2023

THIS SOFTWARE IS PROVIDED BY THE COPYRIGHT HOLDERS AND CONTRIBUTORS "AS IS" AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE COPYRIGHT OWNER OR CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

DISCLAIMER

The information contained in this publication is subject to change without notice. The SNIA makes no warranty of any kind with regard to this publication, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. The SNIA shall not be liable for errors contained herein or for incidental or consequential damages in connection with the furnishing, performance, or use.

Suggestions for revisions should be directed to http://www.snia.org/feedback/.

Current Revision

SNIA is actively engaged in expanding and refining the Swordfish documentation. The most current revision can be found on the SNIA web site at https://www.snia.org/tech_activities/standards/curr_standards/swordfish.

Contact SNIA

Current SNIA practice is to make updates and other information available through their web site at http://www.snia.org.

FEEDBACK AND INTERPRETATIONS

Requests for interpretation, suggestions for improvement and addenda, or defect reports are welcome. They should be sent via the SNIA Feedback Portal at

© ISO/IEC 2023 – All rights reserved

Documents
Document Sharing Hub

Full document details: ISO_IEC 5965_2023

http://www.snia.org/feedback/ or by mail to the Storage Networking Industry Association, 4360 ArrowsWest Drive, Colorado Springs, Colorado 80907, U.S.A.

INTENDED AUDIENCE

This document is intended for use by individuals and companies engaged in storage management.

VERSIONING POLICY

This document is versioned material. Versioned material shall have a three-level revision identifier, comprised of a version number 'v', a release number 'r' and an errata number 'e'. Future publications of this document are subject to specific constraints on the scope of change that is permissible from one revision to the next and the degree of interoperability and backward compatibility that should be assumed between products designed to this standard. This versioning policy applies to all SNIA Swordfish versioned materials.

Version Number: Versioned material having version number 'v' shall be backwards compatible with all of revisions of that material that have the same version number 'v'. There is no assurance of interoperability or backward compatibility between revisions of a versioned material with different version numbers.

Release Number: Versioned material with a version number 'v' and release number 'r' shall be backwards compatible with previous revisions of the material with the same version number, and a lower release number. A minor revision represents a technical change to existing content or an adjustment to the scope of the versioned material. Each minor revision causes the release number to be increased by one.

Errata Number: Versioned material having version number 'v', a release number 'r', and an errata number 'e' should be backwards compatible with previous revisions of the material with the same version number and release number ("errata versions"). An errata revision of versioned material is limited to minor corrections or clarifications of existing versioned material. An errata revision may be backwards incompatible, if the incompatibility is necessary for correct operation of implementations of the versioned material.

Revision History

The evolution of this document is summarized in Table 1.

© ISO/IEC 2023 – All rights reserved

Documents Document Sharing Hub

Full document details: ISO_IEC 5965_2023

Table 1: Revision history

Date	Rev	Notes
19 September 2016	1.0.0	Initial Release
12 October 2016	1.0.1	Errata release for general clean up and formatting consistency
1 November 2016	1.0.2	Errata release to change multiple collections' types from collections (arrays) to ResourceCollections to conform to Redfish usage guidelines Change multiple collections' types from collections (arrays) to ResourceCollections to conform to Redfish usage guidelines and move NavigationProperties from Links section.
24 January 2017	1.0.3	Errata release to move complex types and enum to versioned namespace Schedule schema: add property json schema fix (Swordfish to swordfish) Specification enhancements, multiple areas User's guide: multiple new use cases and new document section
25 April 2017	1.0.4	Errata release with minor updates to schema: move FileShare collection, integrate DMTF and SNIA versions of Volume, fix incorrect property references and update descriptions. Update mockups. User's guide: Update cross-references.
3 October 2017	1.0.5	Errata release to include schema simplifications and other lessons from initial implementations, as well as general cleanup of specification.
13 February 2018	1.0.6	Updated Storage Systems model – added notion of Integrated Service Configuration in addition to (and named) Hosted Service Configuration Added ComplexType common definition section

© ISO/IEC 2023 – All rights reserved

Documents
Document Sharing Hub
Full document details: ISO_IEC 5965_2023

Date	Rev	Notes
		Added/updated common Redfish property definitions
		Updates to conform to new SNIA templates.
12 October 2018	1.0.7	Enhanced Spare Capacity Management Model; Deprecated Remaining Capacity
		Added OpenAPI support: schema references and OpenAPI YAML files
		Added iSCSI properties for CHAP
		Event usage enhancements and guidance
		Volume schema updates – RAID Type enum (deprecating VolumeType usage), add ReplicaTargets
		Schema updates: Annotations enhancements: Capabilities designations, owning entities, Redfish.Required usage
		Clarified and updated ClassOfService IsDefault property usage
		Updated Capabilities location in hierarchy
		Fix cardinality issue of StorageReplicaInfo usage in StorageGroups and Volume
		Consolidate Client and Server Endpoint Groups into single Endpoint Group entity (deprecate usage of separate Client Endpoint Group and Server Endpoint Group)
		Add MappedVolume construct to StorageGroup – adds LUN info and other properties
		Clarified and updated ClassOfService IsDefault property usage
		Updated Capabilities location in hierarchy
		Fix cardinality issue of StorageReplicaInfo usage in StorageGroups and Volume

© ISO/IEC 2023 – All rights reserved

Documents
Document Sharing Hub
Full document details: ISO_IEC 5965_2023

Date	Rev	Notes
		Consolidate Client and Server Endpoint Groups into single Endpoint Group entity (deprecate usage of separate Client Endpoint Group and Server Endpoint Group)
		Add MappedVolume construct to StorageGroup – adds LUN info and other properties
8 November 2018	1.0.7a	Restored RAIDType property that was missing from 1.0.7
		Minor correction to schema versioning
22 August 2019	1.1.0	Restructured to add features and profiles
		Add description of SupportedFeatures usage and requirements
		Add requirements for subsets of Add language to clarify support for use with and without the class of service (now an optional feature)
		Added descriptions of support for seamless extension of Redfish Storage model to Swordfish
		Add updated model diagrams to reflect new model permutations
		Added descriptions of new constructs (e.g., Consistency Groups)
		Cleaned up references to Redfish Specification based on latest version
		Add Status Codes clarification and constraints section
12 November 2019	1.1.0	Released as Technical Position
12 November 2019	1.1.0a	Released as Corrected Technical Position
		Formatting fixes – word wrap in pdf doc format to fix truncated lines
		Consistent object labeling in images (replace drive with disk)

© ISO/IEC 2023 – All rights reserved

Documents
Document Sharing Hub

Full document details: ISO_IEC 5965_2023

Date	Rev	Notes
		Editorial and grammar changes and cleanup to status code guidance section
24 March 2020	1.1.0b	Released as Corrected Technical Position TLS requirements now based on both ISO and SNIA standards Redfish references now based on both ISO and SNIA standards Bibliography added
29 May 2020	1.2.0	Note: This release is done in conjunction with the DMTF's Redfish Forum Work-in-Progress June 2020 release of DSP-IS0014 (v0.95), which contains multiple schema to support this work. Both are released as Working Drafts / work-in-progress for public review, and plan simultaneous releases in early fall 2020 to support full technical specification level capability and availability. Functionality availability in Swordfish includes: • Enhancements to Volume, StoragePools • New schema: NVMeDomain Other supporting documentation released in conjunction with this specification and schema bundle: • Multiple mockups reflecting multiple implementation permutation options (available on swordfishmockups.com) • Model overview documentation (NVMe to RF/SF Model Mapping Working Draft, dated May 2020)
18 August 2020	1.2.1	Note: This release is done in conjunction with the DMTF's Redfish Forum 2020.3 Release of the Redfish Specification, schema bundle and other supporting materials. Functionality availability in Swordfish includes:

© ISO/IEC 2023 – All rights reserved

Documents
Document Sharing Hub
Full document details: ISO_IEC 5965_2023

Date	Rev	Notes
		• NVMe Mapping Support, Enhancements to Volume, StoragePools Additional Enhancements in the Specification and schema: • Added InitializeMethod property to Volume. • Made DedicateSpareDrives ReadWrite-able • Added enhanced Volume Access Capabilities and usage in StorageGroup. • Fix multiple URI issues across various schema. Updated formatting of tables to support automatic table numbering and ISO compatible table representation.
29 September 2020	1.2.1a	Added bibliography and updated TLS references
20 October 2020	1.2.1c	Updated with additional Redfish.URI annotations.
31 October 2020	1.2.1c	Released as SNIA Standard
2 March 2021	1.2.2	Added sections to document use of complex types. Updated common properties sections. Schema changes: Add actions to Add and Remove drives directly from StoragePool. Split NVMeFirmwareImage and NVMeDomains schemas. Deprecate use of NetworkPort; replace with Port. Update Redfish.URI references. Corrected $ref references in JSON schema files. Fix incorrect references in deprecated JSON files.
30 August 2021	1.2.3	Adds updates / corrections to Redfish.URI annotations Add IsBootCapable to Volume

© ISO/IEC 2023 – All rights reserved

Documents
Document Sharing Hub

Full document details: ISO_IEC 5965_2023

Date	Rev	Notes
		Add SupportedPoolTypes to StoragePool
5 December 2021	1.2.3	Release as SNIA Standard
12 April 2022	1.2.4	Release as Working Draft. Schema changes: • FeaturesRegistry: Errata fix – make Features property a collection. • IOStatistics: clarify intent regarding reset / wrap. • StoragePool: errata fixes for Actions. • Volume: errata fixes for Actions. Add: LBAFormatsSupported property to NVMeNamespaceProperties.
12 July 2022	1.2.4a	Release as SNIA Standard. Includes Errata fixes to multiple profiles.

About SNIA

The Storage Networking Industry Association (SNIA) is a non-profit organization made up of member companies spanning information technology. A globally recognized and trusted authority, SNIA's mission is to lead the storage industry in developing and promoting vendor-neutral architectures, standards and educational services that facilitate the efficient management, movement and security of information.

Acknowledgements

The SNIA Scalable Storage Management Technical Work Group, which developed and reviewed this work in progress, would like to recognize the significant contributions made by the following members listed in Table 2.

© ISO/IEC 2023 – All rights reserved

Documents
Document Sharing Hub
Full document details: ISO_IEC 5965_2023

Table 2: Contributors

Member	Representatives (* – prior employer)
Broadcom Inc.	Richelle Ahlvers(*)
Cisco Systems, Inc.	Krishnakumar Gowravaram
Dell Inc.	Patrick Boyd
	George Ericson
	Jim Pendergraft
	Sean McGinnis
	Michael Raineri
	Rich Roscoe
Futurewei Inc.	Sean McGinnis(*)
Hitachi Data Systems	Eric Hibbard
Hewlett Packard Enterprise	Jeff Hilland
	Chris Lionetti
	John Mendonca
	Doug Voigt
Inova Development Inc.	Karl Schopmeyer
Intel Corporation	Richelle Ahlvers
	Rajalaxmi Angadi
	Phil Cayton
	Klaudia Jablonska
	Mariusz Krzywienski
	Mateusz Mania
	Slawek Putyrski
	Paul von Behren
Microsemi Corporation	Anand Nagarjan
Microsoft Corporation	Hector Linares
	Jim Pinkerton

© ISO/IEC 2023 – All rights reserved

Documents
Document Sharing Hub

Full document details: ISO_IEC 5965_2023

Member	Representatives (* – prior employer)
	Michael Pizzo
	Scott Seligman
NetApp, Inc.	Don Deel
	Nilesh Maheshwari
ScienceLogic	Patrick Strick
VMware, Inc.	Murali Rajagopal

© ISO/IEC 2023 – All rights reserved

Documents
Document Sharing Hub
Full document details: ISO_IEC 5965_2023

1 Abstract

The Swordfish Scalable Storage Management API (“Swordfish”) defines a RESTful interface and a standardized data model to provide a scalable, customer-centric interface for managing storage and related data services. It extends the Redfish Scalable Platforms Management API Specification (DSP0266) from the DMTF.

© ISO/IEC 2023 – All rights reserved

Documents
Document Sharing Hub

Full document details: ISO_IEC 5965_2023

2 Scope

2.1 Document Goals

Swordfish extends the Redfish Scalable Platforms Management API Specification to define a comprehensive, RESTful API for storage management that addresses block storage, file systems, object storage, and storage network infrastructure. It is centered around common operational and business concerns of storage management, including:

- Configuration and provisioning
- Monitoring
- Event and log management
- Performance assessment
- Diagnostics
- Fault detection and remediation
- Security
- Accounting and resource consumption

Swordfish's storage model is built around well-defined classes of service, which provide a means to map high-level business goals and objectives to specific, storage-based actions and requirements, in a clear and consistent way that can be applied uniformly across a broad spectrum of storage configurations and storage types (e.g., block storage, file systems, object stores). Common storage management functionality covered by class of service includes snapshots, replication, mapping and masking, and provisioning.

The Redfish specification provides the protocols and a core set of data models and behaviors for the management of systems. It defines the elements and behaviors that are mandatory for all Redfish implementations. Additionally it defines additional elements and behaviors that can be chosen by system vendors or manufacturers. The specifications also defines points at which OEM (system vendor) extensions can be provided by a given implementation. The specifications specifies normative requirements for Redfish Services and associated materials, such as Redfish Schema files. The Redfish specifications does not set requirements for Redfish clients, but will indicate what a Redfish client should do in order to access and utilize a Redfish Service successfully and effectively.

The Swordfish specification defines additional data models and behaviors for the management of storage systems and storage infrastructure. A Swordfish implementation shall conform to all requirements specified in the Redfish specifications.

Documents
Document Sharing Hub
© ISO/IEC 2023 – All rights reserved
Full document details: ISO_IEC 5965_2023

Swordfish is suitable for a wide range of storage, from small-scale object drives, integrated RAID cards or RBODs providing storage services, to external disk arrays or file servers, to infrastructure providing storage services for converged, hyperscale and large scale cloud environments.

This document defines the Swordfish Scalable Storage Management API.

2.2 Audience Assumptions

As Swordfish is designed as an extension of the Redfish specification, this document is written with the presumption that the reader has a detailed understanding of the Redfish specification. This document cannot be fully understood without that context.

© ISO/IEC 2023 – All rights reserved

Documents
Document Sharing Hub

Full document details: ISO_IEC 5965_2023

3 Normative References

3.1 Overview

The documents referenced in Table 3 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) applies.

3.2 Approved references

The approved references that contribute to this document are summarized in Table 3.

Table 3: Approved normative references

Tag	Title (Version)	Author	URL
ISO - 8601	Data elements and interchange formats – Information interchange – Representation of dates and times – Part 1: Basic rules	ISO / IEC	http://www.iso.org/iso/home/store/catalogue_ics/catalogue_detail_ics.htm?csnumber=70907
ISO - Direct	ISO / IEC Directives, Part 2: Principles and rules for the structure and drafting of ISO and IEC documents	ISO / IEC	https://www.iso.org/sites/directives/current/part2/index.xhtml
Redfish	Redfish Scalable Platforms Management API Specification (v1.15.1)	DMTF	https://www.dmtf.org/sites/default/files/standards/documents/DSP0266_1.15.1.pdf
OData	Open Data Protocol (v. 4.01)	OASIS	http://docs.oasis-open.org/odata/odata/v4.01/odata-v4.01-part1-protocol.html

© ISO/IEC 2023 – All rights reserved

Documents
Document Sharing Hub
Full document details: ISO_IEC 5965_2023

Tag	Title (Version)	Author	URL
RFC3986	Uniform Resource Identifier (URI): Generic Syntax (2005)	The Internet Society	http://www.rfc-base.org/txt/rfc-3986.txt
CSDL	Common Schema Definition Language (4.01)	OASIS	https://docs.oasis-open.org/odata/odata/v4.01/odata-v4.01-part3-csdl.pdf
ITIL	ITIL Glossary (2011)	ITIL	https://www.axelos.com/Corporate/media/Files/Glossaries/ITIL_2011_Glossary_GB-v1-0.pdf
Units	The Unified Code for Units of Measure (v2.0.1)	Regenstrief Institute, Inc. and the UCUM Organi-zation	http://unitsofmeasure.org/trac
ISO-20648	Information technology — TLS specification for storage systems	ISO/IEC	https://www.iso.org/standard/68622.html
SPC-4	SCSI Primary Commands - 4 (SPC-4) INCITS 513-2015	T10	http://www.techstreet.com/cgi-bin/joint.cgi/incits
Features	Swordfish Features Registry, version 1.3	SNIA	https://redfish.dmtf.org/registries/swordfish/v1/SwordfishFeatureRegistry.1.3.0.json
Messages	Swordfish Message Registry, version 1.0.2	SNIA	https://redfish.dmtf.org/registries/swordfish/v1/Swordfish.1.0.2.json
EnergyStar	ENERGY STAR® Program Requirements for Data Center Storage	EPA	ENERGY STAR® Program Requirements for Data Center Storage

© ISO/IEC 2023 – All rights reserved

Documents
Document Sharing Hub
Full document details: ISO_IEC 5965_2023

3.3 References under development

Documents referenced in Table 4 are under active development, and subject to revision or replacement at any time. In the event that the provided URL is no longer valid, refer to the related parent page to locate a replacement.

Table 4: References under development

Tag	Title (Version)	Author	URL	Parent Page
RedfishResource	Redfish Resource and Schema Guide	DMTF	https://www.dmtf.org/sites/default/files/standards/documents/DSP2046_2022.1.pdf	http://www.dmtf.org/redfish

3.4 Other references

None defined in this document.

© ISO/IEC 2023 – All rights reserved

Documents
Document Sharing Hub
Full document details: ISO_IEC 5965_2023

4 Terms and Definitions

4.1 Overview

In this document, some terms have a specific meaning beyond the normal English meaning. Those terms are defined in this clause. New terms, frequently used Redfish terms.

4.2 Swordfish-specific Terms

4.2.1 Definitions

The terms listed in Table 5 are used in this document.

Table 5: Swordfish terms

Term	Definition
Entity	An instance of a schema element.
Model	A set of entities and the relationships between them that define the semantics, behavior and state of that set.
OData service	A REST-based service that allows resources, identified using Uniform Resource Locators (URLs) and defined in a model, to be published and edited by Web clients using simple HTTP messages.
Resource	A central element in a model, which represents a physical construct or a logical service, and is further defined by other model entities.
Schema	A formal language representation of a model that conforms to a metamodel.
Service Document	A particular resource that is directly accessed via an OData service entry point. This resource serves as a starting point for locating and accessing the other resources and associated metadata that together make up an instance of a Swordfish service.
Swordfish service	An extension to the Redfish Service that conforms to the Swordfish specification, and provides REST-ful storage management functionality.

© ISO/IEC 2023 – All rights reserved

Documents
Document Sharing Hub
Full document details: ISO_IEC 5965_2023

4.2.2 Symbols and abbreviated terms

None in this document.

4.3 Reference to Redfish terms

Many terms in this document were originally defined in the Redfish Specification. Some of the more common terms and definitions are reproduced in Table 6, as an aid to the reader.

Table 6: Redfish terms

Term	Definition (as of 16 August 2019)
OData	The Open Data Protocol, as defined in OData-Protocol.
OData Service Document	Resource that provides information about the service root for generic OData clients.
Redfish Schema	Defines Redfish Resources according to OData schema representation. You can directly translate a Redfish Schema to a JSON Schema representation.
Redfish service	Implementation of the protocols, resources, and functions that deliver the interface that this specification defines and its associated behaviors for one or more managed systems.
Request	A message from a client to a service.
Service Root	Resource that serves as the starting point for locating and accessing the other resources and associated metadata that together make up an instance of a Redfish Service.

4.4 Keywords (normative language terms)

This document conforms to ISO/IEC Directives, Part 2 for keyword usage. The most common terms and their intended meanings are summarized Table 7.

© ISO/IEC 2023 – All rights reserved

Documents Document Sharing Hub

Full document details: ISO_IEC 5965_2023

Table 7: Normative language terms

Term(s)	Meaning
shall / shall not	Used to identify objectively verifiable criteria to be fulfilled and from which no deviation is permitted if compliance with the document is to be claimed
should / should not	Used to identify a suggested possible choice or course of action deemed to be particularly suitable without necessarily mentioning or excluding others
may / need not	Used to convey consent or liberty (or opportunity) to do something
can / cannot	Expected or conceivable material, physical or causal outcome
must	Identifies a constraint or obligation on the user of the document, typically due to one or more legal requirements or laws of nature, that is not stated as a provision of the standard *NB:* "must" is not an alternative for "shall", and should only be used for constraints that arise from outside this standard

© ISO/IEC 2023 – All rights reserved

Documents
Document Sharing Hub

Full document details: ISO_IEC 5965_2023

5 Swordfish Overview

5.1 Introduction

The Swordfish Scalable Storage Management API ("Swordfish") defines a RESTful interface and a standardized data model to provide a scalable, customer-centric interface for managing storage and related data services. It extends the Redfish Scalable Platforms Management API Specification (DSP0266) from the DMTF.

5.2 Relation to Redfish

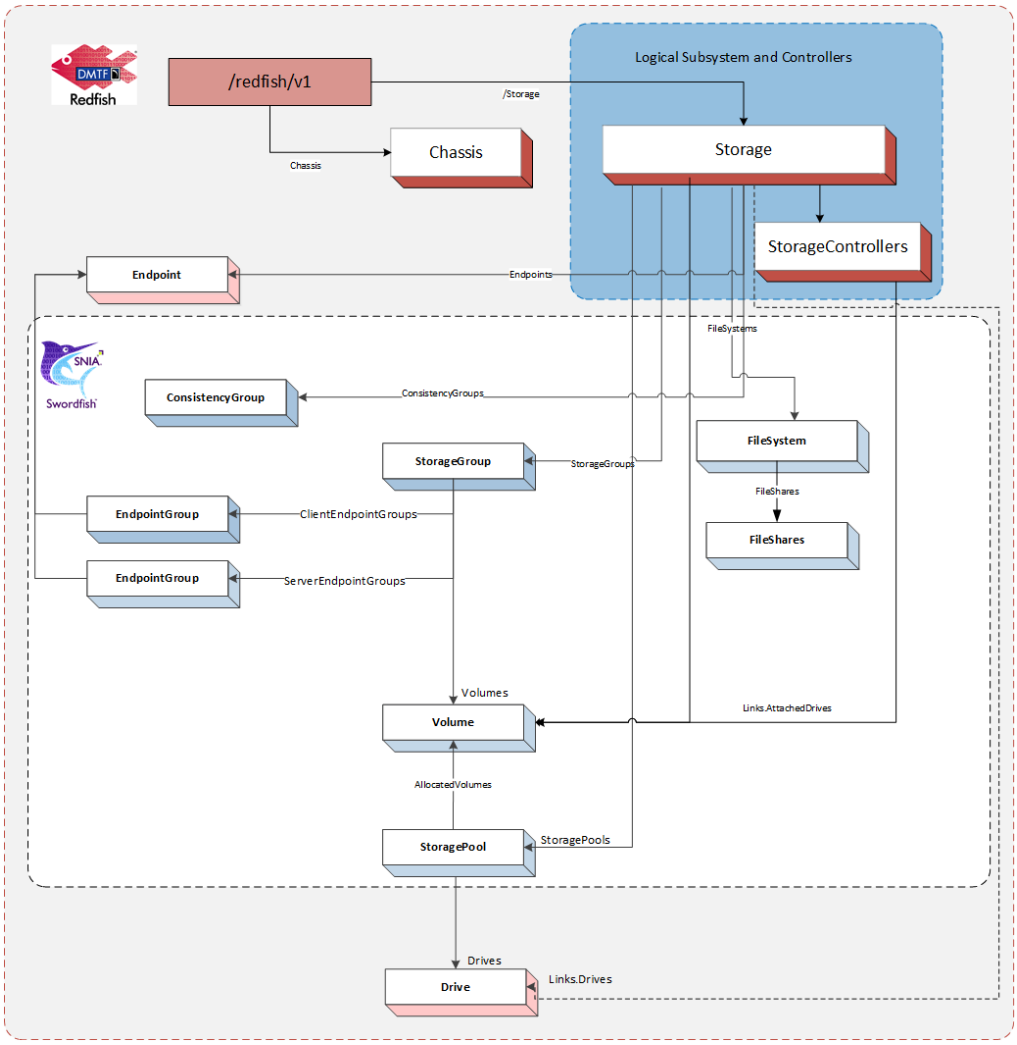

Figure 1: Model Overview

© ISO/IEC 2023 – All rights reserved

Full document details: ISO_IEC 5965_2023

The Swordfish service interface extends the Redfish service interface. As such, a Swordfish service is a Redfish service and includes all required elements of the Redfish model, as illustrated by Figure 1.

The storage systems shall be instantiated in one of two places in the hierarchy: - directly in the `Storage` resource collection, or - attached to a `ComputerSystems`, with an associated reference link in the `StorageSystems` resource collection at the Service Root. In this case, there shall also be a reference link to the `Storage` resource in the `Storage` resource collection at the Service Root.

As a result, a Swordfish client is always to locate the storage systems managed by the Swordfish service in the `ServiceRoot` via the `Storage` resource collection; this may be a combination of references to instances and instantiated instances.

The physical infrastructure is modeled using Redfish `Chassis`.

As modeling for storage systems may cover both logical and physical constructs, Swordfish management clients that are focused on logical storage management use cases may choose to manage functionality entirely by way of logical resources.

Each Swordfish service is accessed via well known URLs on the system supporting the Swordfish Service. Since Swordfish is an extension of Redfish, these URLs are the same as for accessing the Redfish defined aspects of the service.

5.3 Storage System Models

Swordfish has been designed to support a broad range of configurations, requirements, size and complexity, as well as logical and physical architectures. As a result, there are two primary methods of modelling the storage system for a Swordfish implementation:

1. Swordfish Standalone Configuration

The standalone configuration instantiates the logical storage system instance representation in the `Storage` resource collection directly off the Service Root. The logical storage system is modeled using the Redfish `Storage` and `StorageController` resources, as shown in Figure 2. Managed resources are connected to the `Storage` resource, including `Volumes` and `StoragePools`.

© ISO/IEC 2023 – All rights reserved

Documents
Document Sharing Hub
Full document details: ISO_IEC 5965_2023

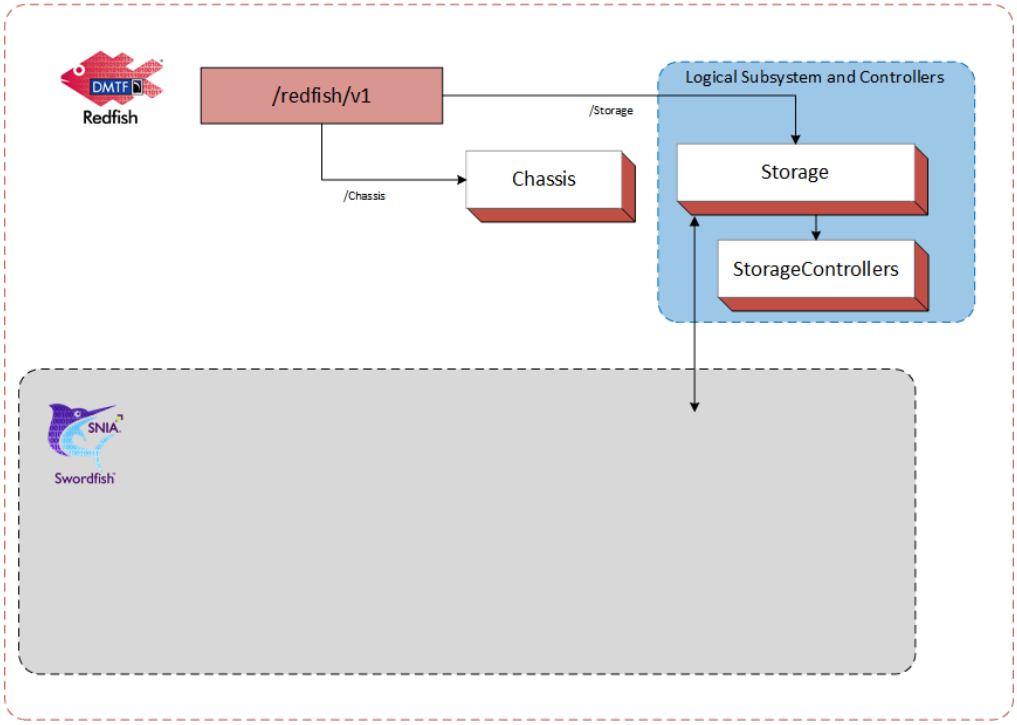

Figure 2: Logical Subsystem in Swordfish Standalone Configuration

This configuration works well for standalone devices or storage systems. An example of a Storage System for an standalone configuration is shown in Figure 3.

© ISO/IEC 2023 – All rights reserved

Documents
Document Sharing Hub
Full document details: ISO_IEC 5965_2023

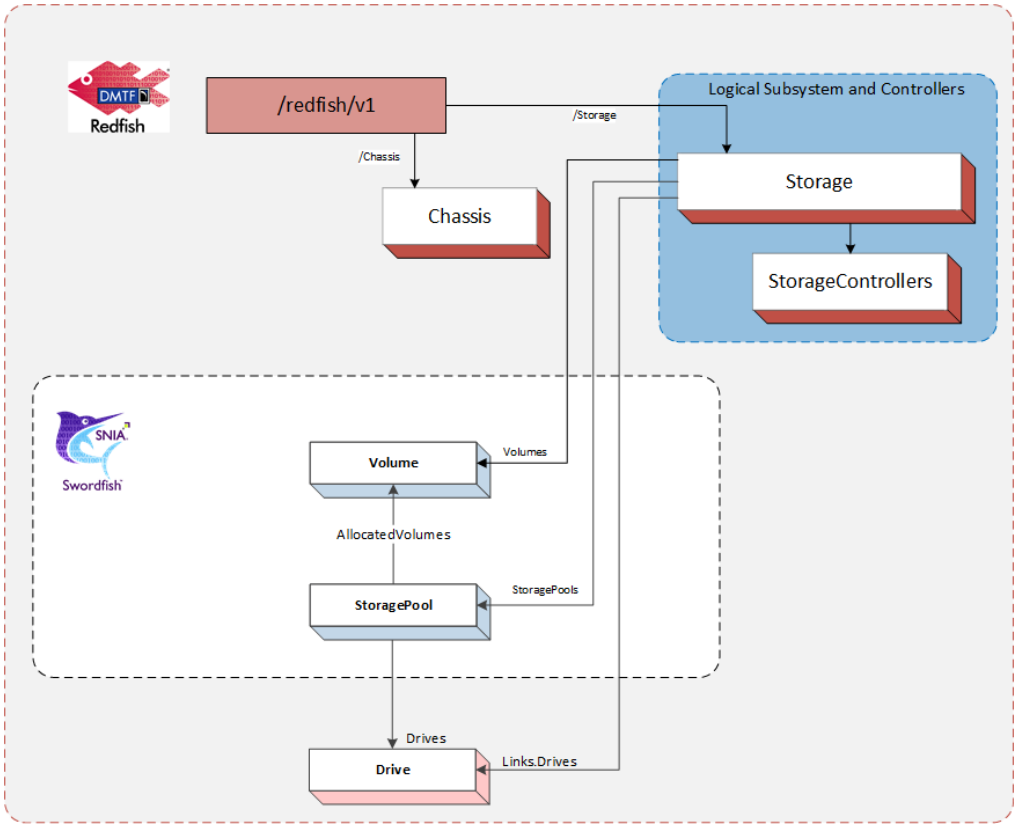

Figure 3: Swordfish Standalone Configuration Example

2. Swordfish Integrated Configuration

The integrated configuration attaches to the `Storage` collection within the same ComputerSystem model instantiation as the server where the physical element resides.

The logical storage system is modeled using the Redfish `Storage` and `StorageController` resources. The `Storage` resource is located in the Redfish hierarchy contained by `ComputerSystems`, typically running as ApplicationServers. The physical infrastructure is modeled using Redfish `Chassis`. Managed resources are connected to the `Storage` resource, including `Volumes` and `StoragePools`.

The integrated configuration is illustrated in Figure 4.

© ISO/IEC 2023 – All rights reserved

Documents
Document Sharing Hub
Full document details: ISO_IEC 5965_2023

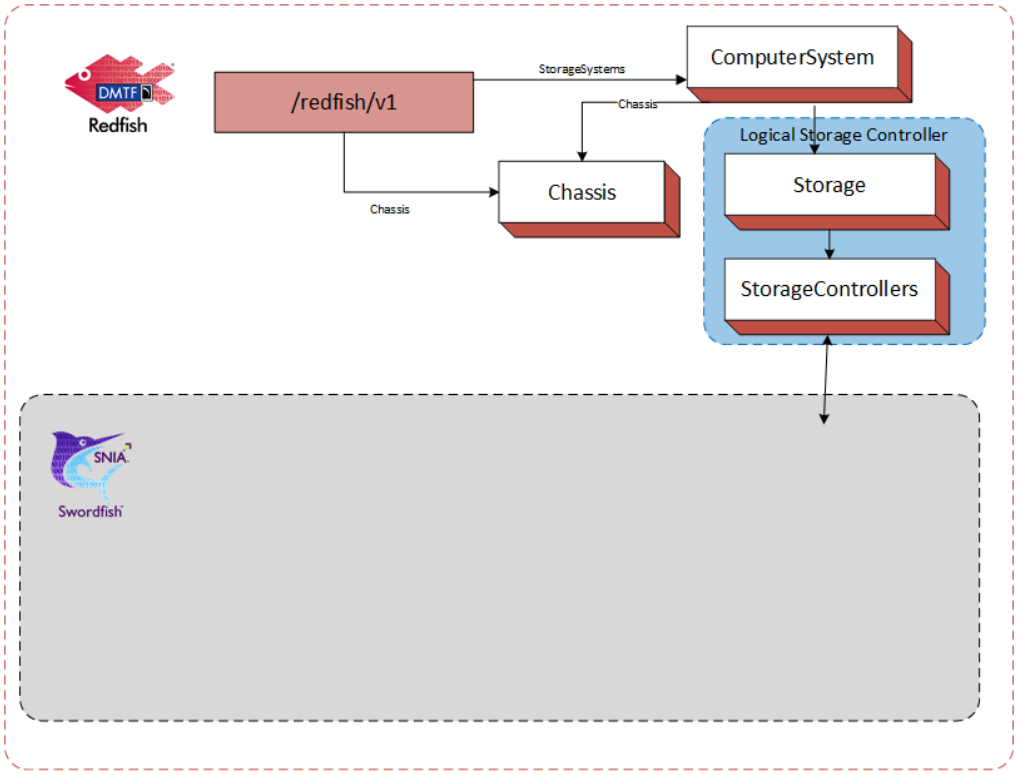

Figure 4: Logical Subsystem in Swordfish Integrated Configuration

This configuration works well when the storage system can be modeled by simply instantiating a new Storage object within an existing computer system. An example of a Storage System for an integrated configuration is shown in Figure ref{Figure_5}.

© ISO/IEC 2023 – All rights reserved

Documents
Document Sharing Hub
Full document details: ISO_IEC 5965_2023

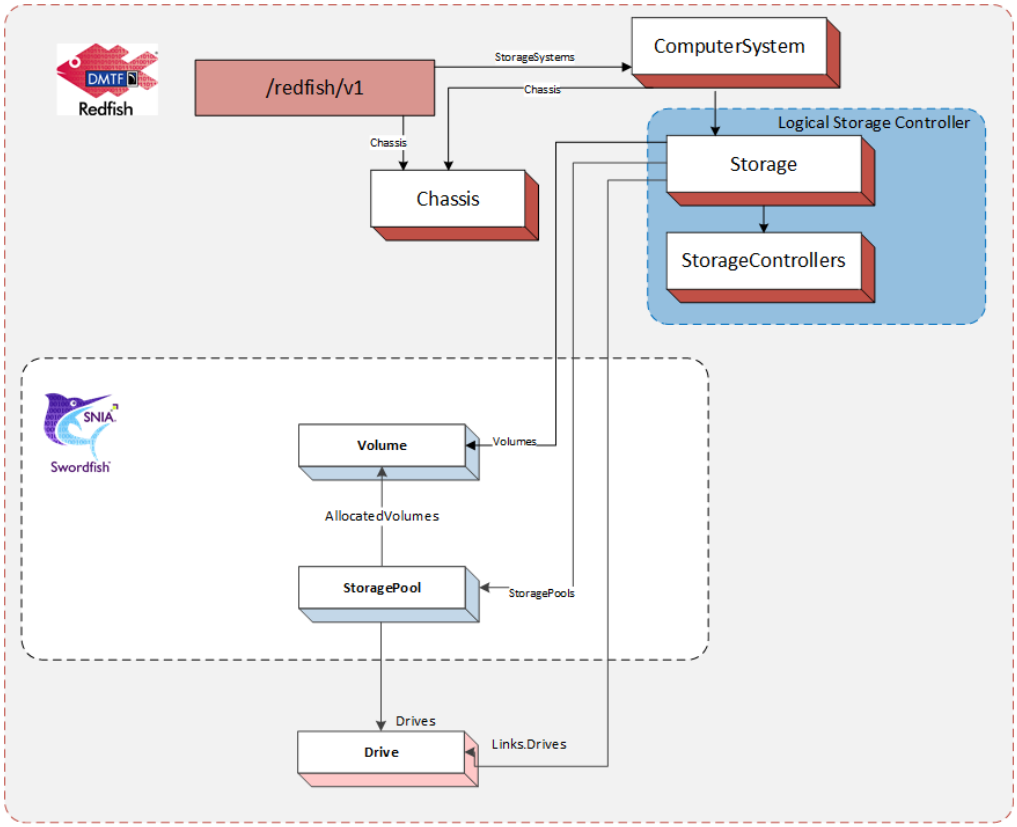

Figure 5: Swordfish Integrated Configuration Example

5.4 The ServiceRoot and ServiceContainer entities

5.4.1 Overview

A **GET** of `/redfish/v1` will return the `ServiceRoot` entity. A **GET** of `/redfish/v1/odata` will return the `ServiceContainer` instances that represents the OData service document. Each of these instances provides links to the remainder of the system.

The following are the elements utilized for Swordfish management.
- `Storage`: A reference to the Storage resource collection. - `Systems`: A reference to a Systems resource collection; - `Chassis`: A reference to a Chassis resource collection; - `StorageSystems`: A reference to a StorageSystems resource collection.

5.4.2 The Storage resource collection

A resource collection that references a set of `Storage` resources that each represents a storage subsystem. This collection can contain either resources or references to

© ISO/IEC 2023 – All rights reserved

Documents
Document Sharing Hub
Full document details: ISO_IEC 5965_2023

instances of `Storage` resources. Each `Storage` resource represents an instance of a storage subsystem. For Swordfish subsystems, refer to the details in the Swordfish model overview for details on required elements.

5.4.3 The Systems resource collection

A resource collection that references a set of `ComputerSystem` resources that each represents a general purpose application server. Each `ComputerSystem` resource will have an entry with the value of "ApplicationServer" in its `HostingRoles` property. A particular `ComputerSystem` resource can be in both the StorageSystems collection and the Systems collection.

5.4.4 The Chassis resource collection

A resource collection that references a set of `Chassis` resources. Each Chassis resource represents physical containers, (i.e. sheet-metal confined spaces and logical zones like racks, enclosures, chassis and all other containers). Subsystems (like sensors), which operate outside of a system's data plane (meaning the resources are not accessible to software running on the system) are linked either directly or indirectly through this resource.

5.4.5 The StorageSystems resource collection

A reference to a `ComputerSystemCollection` with members of type `ComputerSystem` that support storage services. These `ComputerSystem` resources represent systems that support Swordfish storage management services. They will have an entry with the value of "StorageServer" in their `HostingRoles` property. This collection, then, is a resource collection that references a set of `ComputerSystem` resources that each represents a storage server. Each `ComputerSystem` resource will have an entry with the value of "StorageServer" in its `HostingRoles` property. A particular `ComputerSystem` resource can be a member of both the `StorageSystems` resource collection and the `Systems` resource collection.

© ISO/IEC 2023 – All rights reserved

Documents
Document Sharing Hub
Full document details: ISO_IEC 5965_2023

5.5 Swordfish model overview

5.5.1 The Storage resource

The storage system exposes logical storage, associated resources and related functionality. Storage resources can be found in the service root or service container via the `Storage` resource collection, and are attached to the `Storage` object within the `Storage` resource collection.

The storage system typically provides the ability to create, manage and present block, file or object store from a set of back-end media, presented to one or more hosts. Storage controllers can work in coordinated sets of one or more to present value-add capabilities, such as failover, data protection, and data path management within the storage system, that are represented through the various resources within the storage system.

The following are the principal properties of `Storage` that point to resources managed or defined by the storage system:

- `Controllers`: A reference to a resource collection that collects `StorageController` resources.
- `Drives`: A reference to a collection that collects `Drive` resources used for storage.
- `Enclosures`: A reference to a resource collection that collects Chassis resources that contain storage related resources.
- `Endpoints`: A reference to a resource collection that collects `Endpoint` resources used to access storage.
- `EndpointGroups`: A reference to a resource collection that collects `EndpointGroups` resources.
- `FileSystems`: A reference to a resource collection that collects `FileSystem` resources.
- `StorageGroups`: A reference to a resource collection that collects `StorageGroup` resources.
- `ConsistencyGroups`: A reference to a resource collection that collects `ConsistencyGroup` resources.
- `StoragePools`: A reference to a resource collection that collects `StorageGroup` resources.
- `Volumes`: A reference to a resource collection that collects `Volume` resources.

© ISO/IEC 2023 – All rights reserved

Documents
Document Sharing Hub
Full document details: ISO_IEC 5965_2023

5.5.2 The StorageController resource

The storage controller presents the foundational resources used by the storage system. It generally contains connectivity resources between the system and connected consumers.

5.5.3 The Endpoint resource

Endpoints represent one end of a protocol specific connection that supports sending or receiving messages according to a particular protocol.

5.5.4 The Endpoint Collection resource

The `Endpoint` Group is resource collection that references a set of `Endpoint` resources.

5.5.5 The ConsistencyGroup resource

ConsistencyGroups represent a set of volumes that are managed consistently and collectively as a group, to allow system and application level activities to be performed on a set of data that spans volumes. This activities include device-level replication activities as well as system level functions, such as reset.

When ConsistencyGroups are implemented, they are attached to a `Storage` resource and its internal `Volumes` collection is constructed from a subset of the `Volumes` collection of the `Storage` resource.

5.5.6 The ConsistencyGroup Collection resource

The `ConsistencyGroupCollection` is a resource collection that references a set of `ConsistencyGroup` resources.

5.5.7 The StorageGroup resource

StorageGroups represent a set of volumes that are managed as a group in order to facilitate mapping and masking, in which the volumes of a storage group are collectively exposed or hidden to a set of clients.

© ISO/IEC 2023 – All rights reserved

Documents
Document Sharing Hub
Full document details: ISO_IEC 5965_2023

The set of volumes is specified by the `Mapped Volumes` attribute. `MappedVolumes` is a resource collection of the `Mapped Volume` construct (a tuple of a pointer to a volume and a corresponding Logical Unit Number for that volume).

The set of client endpoints to which the volumes can be exposed is specified by the `ClientEndpointGroups`attribute. The `ClientEndpointGroup` resource specifies a collection of `EndpointGroup` resources.

The set of server endpoints to which the volumes can be exposed is specified by the `ServerEndpointGroups`attribute. The `ServerEndpointGroup` resource specifies a collection of `EndpointGroup` resources.

5.5.8 The StoragePool resource

The `StoragePool` resource represents unassigned storage capacity that can be used to produce storage volumes or other storage pools.

The following are the principal properties of `StoragePool` that are used to create or identify resources provisioned or supported by the storage pool:

- `AllocatedVolumes`: A reference to a resource collection that collects `Volume` resources that have been provisioned from the storage pool.
- `AllocatedPools`: A reference to a resource collection that collects `StoragePool` resources that have been provisioned from the storage pool.
- `CapacitySources`: A reference to a resource collection that provides pointers to the capacity sources that are used to provide the underlying capacity for this storage pool.
- `RAIDTypes[]`: The set of RAIDTypes supported by this StoragePool. This may be set upon StoragePool creation, or may be a reflection of the implementation's ability to support different RAID types. Consumers may use this property to determine what RAID types are available from specific StoragePool instances for additional Volume creation requests, or what RAIDTypes have been applied to Volumes already allocated.

5.5.9 The Volume resource

`Volume` resource represents a block-addressable container of storage, sometimes referred to as a "Logical Unit", "LU", "LUN", or "StorageVolume" in the storage industry.

© ISO/IEC 2023 – All rights reserved

Documents
Document Sharing Hub

Full document details: ISO_IEC 5965_2023

5.5.10 The FileSystem resource

This `FileSystem` resource represents a file system. Each `FileSystem` may contain a collection of `FileShares` that can be presented to hosts.

© ISO/IEC 2023 – All rights reserved

Documents
Document Sharing Hub
Full document details: ISO_IEC 5965_2023

6 Features and Profiles

6.1 Overview

Features are high-level descriptions of functionality which an implementation uses to advertise what functionality it currently supports, and for some features, is capable of supporting.

The detailed definitions required to describe to implementers how to implement a feature are written in profile definition files. A feature is generally represented in one (but may be more) profile definition file, or profile.

Profiles are detailed descriptions that describe down to the individual property level what functionality is required in order to advertise features. Different profile definitions can exist for the same feature type but for various types of storage configurations: Swordfish.Block.Provisioning, Swordfish.File.Provisioning

The Swordfish Features Registry shall be used to advertise what standard and Oem Features an implementation supports.

6.2 Requirement for SupportedFeatures

`SupportedFeatures` entries in the `Features` registry represent the client's primary initial runtime view of the capabilities of a Swordfish implementation. Without properly formed entries in this registry, there is no visibility to an implementation's functionality.

Swordfish implementations shall implement the `Features` registry and advertise at least the `SNIA.Swordfish.Discovery` supported feature in order to be considered a Swordfish implementation.

Features define coarse-grained sets of functionality. In order to advertise a feature (using the `SupportedFeature` mechanism in the SupportedFeatures Registry), the implementation must support the complete set of functionality as defined in the corresponding profile.

The Swordfish Features Registry publishes the official list of supported SNIA Features, and provides a high-level description of their functionality. Many of those features are self-explanatory (e.g., local replication, remote replication), but there are some features where additional context is appropriate:

- Class of Service
- Energy Star for Storage

© ISO/IEC 2023 – All rights reserved

Documents
Document Sharing Hub

Full document details: ISO_IEC 5965_2023

6.3 EnergyStar for Storage Feature

The EnergyStar for Storage Feature and profile has been created to formalize the requirements from the ENERGY STAR Data Center Storage Program Requirements on storage products. The profile indicates what properties Swordfish implementations need to support in order to properly instrument EnergyStar reporting capability. This functionality is intended to support EnergyStar data gathering requirements as part of the EnergyStar certification process.

6.4 Class of Service Feature

6.4.1 Overview

Swordfish supports a `ClassOfService` feature. The `ClassOfService` functionality supports systems that are capable of providing a greater level of management automation, where a higher-level set of goals is provided as direction rather than requiring parameterized inputs for all configuration actions.

The Class of Service feature uses a combination of device-defined capabilities to structure LinesOfService, which are sets of available functionality in a given system, that can then be grouped together to provide classes of service.

When Class of service functionality is implemented, the Swordfish functionality may be entirely exposed through the StorageService resource. Each Swordfish StorageService is located in the ServiceRoot (and ServiceContainer) via the StorageServices resource collection.

6.4.2 Class of Service Model

For Swordfish with a class of service interface, the following two models apply. Either model choice results in the same storage service, regardless of the storage system model.

1. Integrated Service Configuration

The storage systems managed by the Swordfish storage service are modeled using the Redfish `Storage` resource and `StorageController` resource collections. The `Storage` resource is located in the Redfish hierarchy contained by `ComputerSystems`, typically running as ApplicationServers. The physical infrastructure is modeled using Redfish `Chassis`, as shown in Figure 6.

© ISO/IEC 2023 – All rights reserved

Documents
Document Sharing Hub
Full document details: ISO_IEC 5965_2023

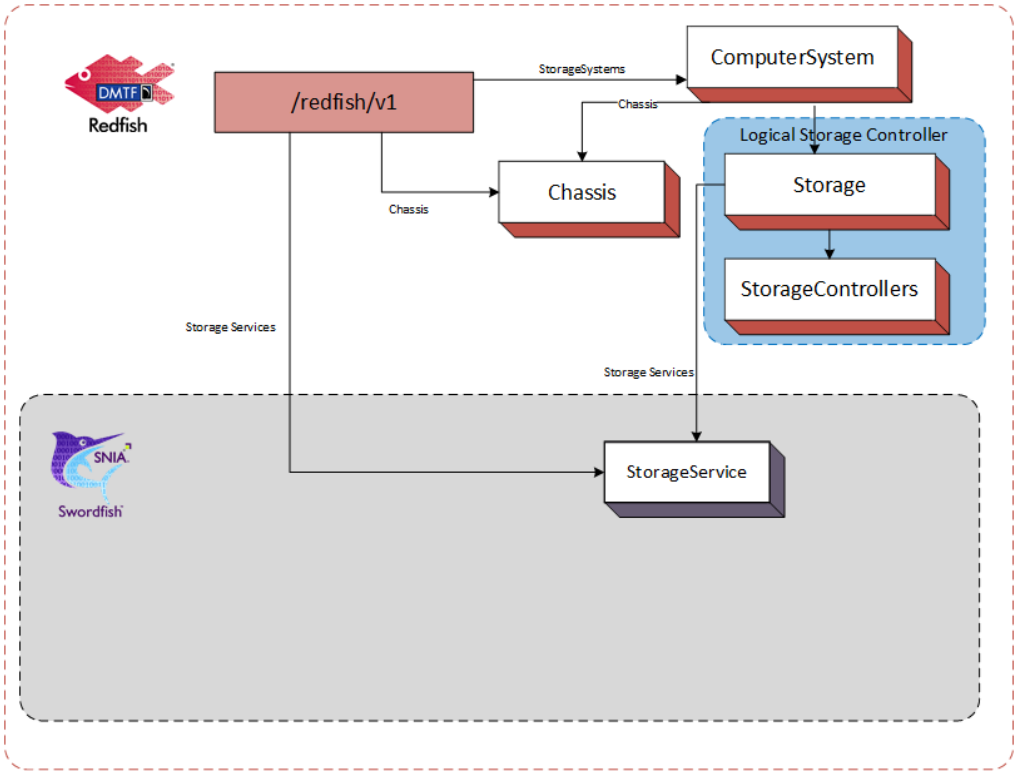

Figure 6: Logical Subsystem in Integrated Service Configuration

This configuration works well when the storage service is hosted by a storage resource within a computer system. An example of a Storage Service for an integrated service configuration is shown in Figure 7.

> Note: This diagram and the discussion of the configuration description have been simplified slightly to avoid confusion. A full implementation would likely include additional links to the logical storage controller resources.

© ISO/IEC 2023 – All rights reserved

Documents
Document Sharing Hub

Full document details: ISO_IEC 5965_2023

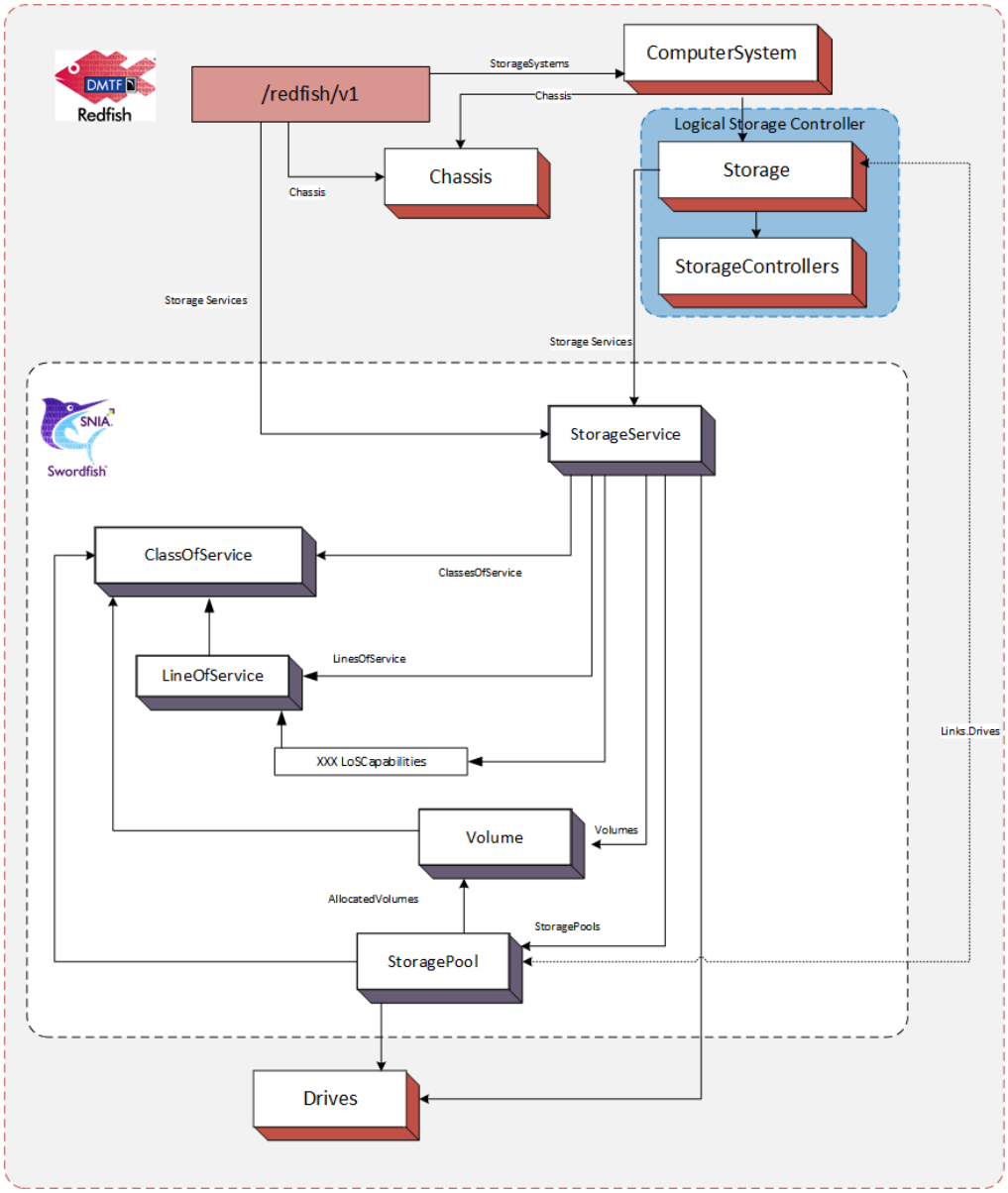

Figure 7: Integrated Service Configuration Example

2. Standalone Service Configuration

The storage systems managed by the Swordfish storage service are located in the `ServiceRoot` (and `ServiceContainer`) via the `Storage` resource collection. They model the logical storage system using Redfish `Storage` and 'StorageController' resources. The physical infrastructure is modeled using Redfish `Chassis`. This is shown in Figure 8.

© ISO/IEC 2023 – All rights reserved

Full document details: ISO_IEC 5965_2023