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Foreword

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This document was prepared by SNIA (as Storage Management Technical Specification, Part 5 Filesystems, Version 1.8.0, Revision 5) 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 24775-5:2014), which has been technically revised.

The main changes compared to the previous edition are as follows:

— USAGE text was revised to address code (now included in the front matter for all SNIA specifications)

— All recipes and their references were deleted.

— Instances of subprofile were changed to profile. In the annex, instances of subprofile were changed to component profile (TSG meeting voice vote).

— Profile versions and related text were updated. (TSG meeting voice vote).

— Indications have been replaced by DMTF Indications, and all affected clauses updated. (TSG meeting voice vote).

— Instances of Experimental within profiles already labeled as Experimental were removed to avoid confusion and redundancy. (Editorial change)

— CIM/XML was changed to CIM-XML (Response to ballot comments).

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— Annex: SMI-S Information Mo

— The CIM schema version was changed to 2.51 for V1.8.0 Rev3.

— Multiple profiles

  — Changed LocalAccessAvailable LocalAccessAvailableToFS, to respond to a DMTF change.

— File Export Profile (SMIS-170-Draft-SCR00004)

  — Removed the deprecated LogicalFile, ConcreteDependency and FileStorage from the diagrams.
  — Removed GetElementNameCapabilities from CIM_EnabledLogicalElementCapabilities (moved to the File Export Manipulation Profile).
  — Changed the FileShare reference in CIM_SAPAvailableForFileShare to ManagedElement to match the mof.
  — Added mandatory indications for FileShare.

— File Export Manipulation Profile

  — Added missing figure: FileShares and Simple Identity Management in Section 5.1.3.3.
  — Promoted all draft material to Experimental.
  — Promoted to Stable (TSG-SMIS-SCR00319).
  — Changed requirement to Mandatory and description for ProtocolVersions property in Tables 33-36.
  — Changed requirement to Mandatory for FileSharingProtocol property in Table 34.
  — Added material associated with the DMTF Simple Identity Management Profile (DS1034 rev 1.1.0 as it pertains to ACL manipulation on file shares. (TSG-SMIS-SCR00317).
  — Removed the deprecated LogicalFile, ConcreteDependency and FileStorage from the diagrams.
  — Fixed the duplicate entry for CIM_AccountManagementService (the second one was changed to CIM_AssociatedPrivilege).
  — Removed the deprecated CIM_ConcreteDependency, CIM_FileStorage and CIM_LogicalFile from the CIM Elements table.
  — Fixed the entries for CIM_ElementCapabilities in the CIM Elements table.
  — Added Key properties in the CIM_AccountManagementService CIM Elements table.
  — Added the method GetElementNameCapabilities to CIM_ExportedFileShareCapabilities.
  — Changed the FileShare reference in CIM_SAPAvailableForFileShare to ManagedElement to match the mof.
  — Added a Key property in the CIM_UserContact CIM Elements table.

— File Server Manipulation Profile

  — Changed CanConfigureNetworkVLSN in the class CIM_FileServerConfigurationCapabilities to CanConfigureNetworkVLAN to match the mof.
  — Fixed the PartComponent reference in CIM_SettingsDefineCapabilities (DNSSettingData) to refer to DNSSettingData.
  — Promoted to Stable (TSG-SMIS-SCR00319).

— File Storage Profile

  — Changed the Central Class from N/A to CIM_LogicalDisk (SMIS-180-Errata-SCR00003).
  — Changed the Scoping Class from ComputerSystem to CIM_LocalFileSystem (SMIS-180-Errata-SCR00003).

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— Filesystem Profile

— Added mandatory indications for LocalFileSystem (SMIS-170-Draft-SCR00004).
— Material related to ElementCapabilities (naming) incl 8.1.2.3: Promoted to Stable (TSG-SMISSCR00319).
— Removed the deprecated LogicalFile, ConcreteDependency and FileStorage from the diagrams.
— Removed the deprecated CIM_ConcreteDependency, CIM_FileStorage and CIM_LogicalFile from the CIM Elements table.
— Removed GetElementNameCapabilities from CIM_EnabledLogicalElementCapabilities (moved to the Filesystem Manipulation Profile).

— Filesystem Manipulation Profile

— Material related to ElementCapabilities (naming) in 9.1.3.1: Promoted to Stable (TSG-SMIS-SCR00319).
— Fixed the version numbers on the Related Profiles to match what the profiles claim.
— Removed the deprecated LogicalFile, ConcreteDependency and FileStorage from the diagrams.
— Fixed the description of the Capabilities reference in CIM_ElementCapabilities (Local Access Configuration Capabilities).
— Added descriptions to the references and property in CIM_ElementCapabilities (Default).
— Added descriptions to the references in CIM_ElementCapabilities (Non-Default).
— Added the GetElementNameCapabilities() method to CIM_FileSystemCapabilities.

— Filesystem Performance Profile

— Changed FileSystemStorageStatisticalData to FileSystemStatisticalData in a diagram and the CIM Element table for CIM_FileSystemStatisticalData.

— Filesystem Quotas Profile

— Fixed queries in CIM table 173.
— Changed the name of the Profile from FileSystem Quotas to Filesystem Quotas.
— Added a missing ElementCapabilities between CIM_FSQuotaCapabilities and CIM_FSQuotaManagementService (as depicted in the instance diagram).
— Added a definition for CIM_LogicalFile which is depicted in the instance diagram, but is not in the CIM Elements table.

— Filesystem Replication Services Profile

— Changed the name of the Clause to match the name of the Profile.
— Fixed the method named GetReplicationRelationshipInstance to be GetReplicationRelationshipInstances.
— Added DESC to references in CIM_ElementCapabilities, CIM_FileSystemSynchronized, CIM_HostedCollection, CIM_MemberOfCollection, CIM_OrderedMemberOfCollection and CIM_ReplicaPoolForStorage.
— Added a CIM Element table to describe properties for CIM_FileSystemGroupSynchronized.
— Changed the DESC for the ManagedElement in SettingsDefineState.

— Filesystem Quotas Profile

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— Changed the Central Class from LocalFileSystem to CIM_FSQuotaManagementService (TSG-SMISSCR00333).

— Host Filesystem Profile

— In the package diagram, changed Filesystem Copy Services to Filesystem Replication Services and deleted Experimental Indications.
— Added descriptions for references in CIM_HostedCollection (Remote Resources), NAS Head Profile (TSG-SMIS-SCR00333).
— Changed both the Central Class and Scoping Class from ComputerSystem to CIM_ComputerSystem (Top Level System).

— NAS Head Profile

— Promoted 12.1.3.8.1 to Stable (TSG-SMIS-SCR00319).
— Promoted the maturity level from DRAFT to EXPERIMENTAL: Updated profiles to remove SNIA_ classes and use DMTF CIM_ classes (TSG-SMIS-SCR00315.001).
— Revised CIM_AssociatedPrivilege; Added CIM_UserContact, CIM_Identity, CIM_AccountMapnagementService, CIM_AssignedIdentity.
— Fixed the version numbers on the Related Profiles to match what the profiles claim.
— In the package diagram, removed Cascading and added Filesystem Performance and Filesystem Replication Services.
— Removed the deprecated LogicalFile, ConcreteDependency and FileStorage from the instance diagram.

— NAS Network Port Profile

— Fixed the description of CIM_FSIPInterfaceSettingData in the CIM Elements table.
— Deleted the extra CIM_FSIPInterfaceSettingData from the CIM Elements table CIM_MemberOfCollection (Allocated Resources) and CIM_MemberOfCollection (Remote Resources).
— Changed the Central Class from ProtocolEndpoint to CIM_ProtocolEndpoint (CIFS or NFS) (TSG-SMISSCR00333).

— Self-Contained NAS Profile

— Promoted 13.1.3.1, 13.1.3. 2 (TSG-SMIS-SCR00319).
— Fixed the version numbers on the Related Profiles to match what the profiles claim.
— In the package diagram, changed Filesystem Copy Services to Filesystem Replication Services.
— Removed the deprecated LogicalFile, ConcreteDependency and FileStorage from the instance diagram.
— Added a CIM Element table for CIM_ElementCapabilities (ImplementationCapabilities to Service).
— Changed both the Central Class and Scoping Class from ComputerSystem to CIM_ComputerSystem (Top Level System) (TSG-SMIS-SCR00333).

— Annex A SMI-S Information Model

— Deleted “Most SMI-S Profiles are primarily based on the DMTF Final MOFs” per 5/22/15 TSG meeting consensus.
— DMTF’s CIM schema version changed to 2.45.0. (TSG meeting voice vote).

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— References

— Added DMTF DSP1054 v1.2.2, Indications Profile (and changed version to 1.2.2 throughout book).
— Updated reference to DMTF DSP1054 Indications Profile.
— Removed DSP0214.
— Removed year from DSP1034del.

A list of all parts in the ISO/IEC 24775 series can be found on the ISO website.

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INTENDED AUDIENCE

This document is intended for use by individuals and companies engaged in developing, deploying, and promoting interoperable multi-vendor SANs through the Storage Networking Industry Association (SNIA) organization.

CHANGES TO THE SPECIFICATION

Each publication of this specification is uniquely identified by a three-level identifier, comprised of a version number, a release number and an update number. The current identifier for this specification is version 1.8.0. Future publications of this specification are subject to specific constraints on the scope of change that is permissible from one publication to the next and the degree of interoperability and backward compatibility that should be assumed between products designed to different publications of this standard. The SNIA has defined three levels of change to a specification:

- Major Revision: A major revision of the specification represents a substantial change to the underlying scope or architecture of the SMI-S API. A major revision results in an increase in the version number of the version identifier (e.g., from version 1.x.x to version 2.x.x). There is no assurance of interoperability or backward compatibility between releases with different version numbers.

- Minor Revision: A minor revision of the specification represents a technical change to existing content or an adjustment to the scope of the SMI-S API. A minor revision results in an increase in the release number of the specification's identifier (e.g., from x.1.x to x.2.x). Minor revisions with the same version number preserve interoperability and backward compatibility.

- Update: An update to the specification is limited to minor corrections or clarifications of existing specification content. An update will result in an increase in the third component of the release identifier (e.g., from x.x.1 to x.x.2). Updates with the same version and minor release levels preserve interoperability and backward compatibility.

TYPOGRAPHICAL CONVENTIONS

Maturity Level

In addition to informative and normative content, this specification includes guidance about the maturity of emerging material that has completed a rigorous design review but has limited implementation in commercial products. This material is clearly delineated as described in the following sections. The typographical convention is intended to provide a sense of the maturity of the affected material, without altering its normative content. By recognizing the relative maturity of different sections of the standard, an implementer should be able to make more informed decisions about the adoption and deployment of different portions of the standard in a commercial product.

This specification has been structured to convey both the formal requirements and assumptions of the SMI-S API and its emerging implementation and deployment lifecycle. Over time, the intent is that all content in the specification will represent a mature and stable design, be verified by extensive implementation experience, assure consistent support for backward compatibility, and rely solely on content material that has reached a similar level of maturity. Unless explicitly labeled with one of the subordinate maturity levels defined for this specification, content is assumed to satisfy these requirements and is referred to as "Finalized". Since much of the evolving specification

content in any given release will not have matured to that level, this specification defines three subordinate levels of implementation maturity that identify important aspects of the content's increasing maturity and stability. Each subordinate maturity level is defined by its level of implementation experience, its stability and its reliance on other emerging standards. Each subordinate maturity level is identified by a unique typographical tagging convention that clearly distinguishes content at one maturity model from content at another level.

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Experimental Maturity Level

No material is included in this document unless its initial architecture has been completed and reviewed. Some content included in this document has complete and reviewed design, but lacks implementation experience and the maturity gained through implementation experience. This content is included in order to gain wider review and to gain implementation experience. This material is referred to as “Experimental”. It is presented here as an aid to implementers who are interested in likely future developments within the SMI specification. The contents of an Experimental profile may change as implementation experience is gained. There is a high likelihood that the changed content will be included in an upcoming revision of the specification. Experimental material can advance to a higher maturity level as soon as implementations are available. Figure 1 is a sample of the typographical convention for Experimental content.

EXPERIMENTAL

Experimental content appears here.

EXPERIMENTAL

Figure 1 - Experimental Maturity Level Tag

Implemented Maturity Level

Profiles for which initial implementations have been completed are classified as “Implemented”. This indicates that at least two different vendors have implemented the profile, including at least one provider implementation. At this maturity level, the underlying architecture and modeling are stable, and changes in future revisions will be limited to the correction of deficiencies identified through additional implementation experience. Should the material become obsolete in the future, it must be deprecated in a minor revision of the specification prior to its removal from subsequent releases. Figure 2 is a sample of the typographical convention for Implemented content.

IMPLEMENTED

Implemented content appears here.

IMPLEMENTED

Figure 2 - Implemented Maturity Level Tag

Stable Maturity Level

Once content at the Implemented maturity level has garnered additional implementation experience, it can be tagged at the Stable maturity level. Material at this maturity level has been implemented by three different vendors, including both a provider and a client. Should material that has reached this maturity level become obsolete, it may only be deprecated as part of a minor revision to the specification. Material at this maturity level that has been deprecated may only be removed from the specification as part of a major revision. A profile that has reached this maturity level is guaranteed to preserve backward compatibility from one minor specification revision to the next. As a result, Profiles at or above the Stable

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maturity level shall not rely on any content that is Experimental. Figure 3 is a sample of the typographical convention for Implemented content.

STABLE

Stable content appears here.

STABLE

Figure 3 - Stable Maturity Level Tag

Finalized Maturity Level

Content that has reached the highest maturity level is referred to as “Finalized.” In addition to satisfying the requirements for the Stable maturity level, content at the Finalized maturity level must solely depend upon or refine material that has also reached the Finalized level. If specification content depends upon material that is not under the control of the SNIA, and therefore not subject to its maturity level definitions, then the external content is evaluated by the SNIA to assure that it has achieved a comparable level of completion, stability, and implementation experience. Should material that has reached this maturity level become obsolete, it may only be deprecated as part of a major revision to the specification. A profile that has reached this maturity level is guaranteed to preserve backward compatibility from one minor specification revision to the next. Over time, it is hoped that all specification content will attain this maturity level. Accordingly, there is no special typographical convention, as there is with the other, subordinate maturity levels. Unless content in the specification is marked with one of the typographical conventions defined for the subordinate maturity levels, it should be assumed to have reached the Finalized maturity level.

Deprecated Material

Non-Experimental material can be deprecated in a subsequent revision of the specification. Sections identified as “Deprecated” contain material that is obsolete and not recommended for use in new development efforts. Existing and new implementations may still use this material, but shall move to the newer approach as soon as possible. The maturity level of the material being deprecated determines how long it will continue to appear in the specification. Implemented content shall be retained at least until the next revision of the specialization, while Stable and Finalized material shall be retained until the next major revision of the specification. Providers shall implement the deprecated elements as long as it appears in the specification in order to achieve backward compatibility. Clients may rely on deprecated elements, but are encouraged to use non-deprecated alternatives when possible.

Deprecated sections are documented with a reference to the last published version to include the deprecated section as normative material and to the section in the current specification with the replacement. Figure 4 contains a sample of the typographical convention for deprecated content.

DEPRECATED

Content that has been deprecated appears here.

DEPRECATED

Figure 4 - Deprecated Tag

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FOREWORD

The Filesystems part of the *Storage Management Technical Specification* contains Profiles and other clauses for management of devices and programs that support filesystems. A filesystem is a specific formatting of storage for storing and accessing files on external storage. This part describes how filesystems are created, modified and deleted, as well as how they can be found and reported. This part also describe modeling for how filesystems are exported for access from remote systems. The filesystem profiles use information from other parts of the Storage Management Technical Specifications. Specifically, they reference profiles in the Common Profiles and the Block Devices parts of the specification. This part describes how these profiles are used in filesystem profiles.

Parts of this Standard

This standard is subdivided in the following parts:

- *Storage Management Technical Specification, Part 1 Overview, 1.8.0 Rev 4*
- *Storage Management Technical Specification, Part 2 Common Architecture, 1.8.0 Rev 4*
- *Storage Management Technical Specification, Part 3 Common Profiles, 1.8.0 Rev 4*
- *Storage Management Technical Specification, Part 4 Block Devices, 1.8.0 Rev 4*
- *Storage Management Technical Specification, Part 5 Filesystems, 1.8.0 Rev 4*
- *Storage Management Technical Specification, Part 6 Fabric, 1.8.0 Rev 4*
- *Storage Management Technical Specification, Part 7 Host Elements, 1.8.0 Rev 4*
- *Storage Management Technical Specification, Part 8 Media Libraries, 1.8.0 Rev 4*

SNIA Web Site

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

SNIA Address

Requests for interpretation, suggestions for improvement and addenda, or defect reports are welcome. They should be sent via the SNIA Feedback Portal at http://www.snia.org/feedback/ or by mail to the Storage Networking Industry Association, 4360 ArrowsWest Drive, Colorado Springs, Colorado 80907, U.S.A.

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1 Scope

The Filesystems part of the *Storage Management Technical Specification* defines management profiles for Autonomous (top level) profiles for programs and devices whose central function is providing support and access to file data. In addition, it provides documentation of component profiles that deal with filesystems and management interface functions that may be used by other autonomous profiles not included in this part of the specification.

There is an informative annex that describes how storage is mapped from block storage to file shares exported by the filesystem and the mechanisms involved in that establishing those mappings. This annex is recommended for getting an overview of how the filesystem models work.

This version of the Filesystems part of the Storage Management Technical Specification includes two autonomous profiles:

- The NAS Head Profile

  This profile defines the model and functions of a NAS device that exports file shares to remote users and gets its storage from a SAN (array devices attached to the NAS Head device).

- The Self-Contained NAS Profile

  This profile defines the model and functions of a NAS device that exports file shares to remote users, but gets its storage from disk drives that are internal to the NAS device (instead of externally attached arrays).

In addition to these autonomous profiles, this part of the specification defines a number of component profiles, which are used by the autonomous NAS profiles and might also be used by other autonomous profiles that feature filesystem elements and services. The component profiles defined in this version of the specification include:

- The File Export (component) Profile

  This component profile defines the elements used to model the exporting of filesystems or directories for any autonomous profile that exports file data to remote systems.

- The File Export Manipulation (component) Profile

  This component profile defines the elements used to model the services for creating, modifying and deleting the file shares (the representation of exported filesystems or directories) for any autonomous profile that provides manipulation of exported filesystems or directories.

- The File Storage (component) Profile

  This component profile defines the elements used to model the storage of filesystems on logical disks. This profile does not have services for maintaining the mapping of filesystems to logical disks. These services are addressed in the Filesystem Manipulation Profile.

- The Filesystem (component) Profile

  This component profile defines the elements used to model filesystems and its related elements, such as logical files, directories and information on how the filesystem is addressed when mounted to a specific system. The services for defining and maintaining the information in the Filesystem Profile are contained in the Filesystem Manipulation Profile.

- The Filesystem Manipulation (component) Profile

  This component profile defines the elements used to model the services for creating, modifying and deleting filesystems and their related elements.

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- The Filesystem Quotas (component) Profile

  This component profile defines the elements used to model the elements associated with creating, maintaining and reporting on quotas on various filesystem elements.

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2 Normative References

2.1 General

The following referenced documents 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.

2.2 References under development

Storage Management Technical Specification, Part 2 Common Architecture, 1.8.0 Rev 4

Storage Management Technical Specification, Part 3 Common Profiles, 1.8.0 Rev 4

Storage Management Technical Specification, Part 4 Block Devices, 1.8.0 Rev 4

2.3 Other references

DMTF DSP1034 Simple Identity Management Profile 1.1.0
http://dmtf.org/sites/default/files/standards/documents/DSP1034_1.1.0.pdf

DMTF DSP1054 Indications Profile 1.2.2
http://www.dmtf.org/sites/default/files/standards/documents/DSP1054_1.2.2.pdf

MS-SMB2: Server Message Block (SMB) Protocol Versions 2 and 3
https://msdn.microsoft.com/en-us/library/cc246482.aspx

IETF ISSN: 2070-1721, Network File System (NFS) Version 4 Minor Version 1 Protocol,
https://tools.ietf.org/html/rfc5661

ISO/IEC 14776-452, SCSI Primary Commands - 3 (SPC-3) [ANSI INCITS.351-2005]

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3 Terms, Definitions, Symbols, Abbreviations, and Conventions

3.1 General

For the purposes of this document, the terms, definitions, symbols, abbreviations, and conventions given in *Storage Management Technical Specification, Part 2 Common Architecture, 1.8.0 Rev 4* and the following apply.

3.2 Terms and Definitions

3.2.1
CIFS
Common Internet File System

3.2.2
Directory
A subtree within a filesystem

A directory may contain files or other directories.

3.2.3
File
A logical file in a filesystem

3.2.4
file server
a system configuration that supports the exporting of files and files systems

Note 1 to entry: A file server may be a virtual system element.

3.2.5
file share
sharing protocols applied to a directory. A directory is exported to remote users through a file share

3.2.6
filesystem
a filesystem in which files are named and placed logically for storage and retrieval

3.2.7
FS quota
a quota (hard or soft limit) placed on filesystem resource usage

3.2.8
logical disk
block storage on which filesystems are built

Note 1 to entry: A logical disk would be formatted for a particular filesystem.

3.2.9
NAS
Network Attached Storage

In the context of this specification this refers to devices that serve files to a network

3.2.10
NAS head
a NAS device that gets its physical storage from one or more arrays that are externally attached to the NAS device

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3.2.11
NFS
Network File System

3.2.12
Self-Contained NAS
a NAS device that has its own internal (to the NAS device) storage

3.2.13
quota
a hard or soft limit defined for users, user groups or resource collections on the amount of resources that may be consumed

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