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iSCSI Implementer's Guide

Abstract

iSCSI is a SCSI transport protocol and maps the SCSI family of application protocols onto TCP/IP. RFC 3720 defines the iSCSI protocol. This document compiles the clarifications to the original protocol definition in RFC 3720 to serve as a companion document for the iSCSI implementers. This document updates RFC 3720 and the text in this document supersedes the text in RFC 3720 when the two differ.

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1 Definitions and acronyms

1.1 Definitions

I/O Buffer A buffer that is used in a SCSI Read or Write operation so SCSI data may be sent from or received into that buffer. For a read or write data transfer to take place for a task, an I/O Buffer is required on the initiator and at least one required on the target.

SCSI-Presented Data Transfer Length (SPDTL): SPDTL is the aggregate data length of the data that SCSI layer logically "presents" to iSCSI layer for a Data-in or Data-out transfer in the context of a SCSI task. For a bidirectional task, there are two SPDTL values one for Data-in and one for Data-out. Note that the notion of "presenting" includes immediate data per the data transfer model in [SAM2], and excludes overlapping data transfers, if any, requested by the SCSI layer.

Third-party: A term used in this document to denote nexus objects (I_T or I_T_L) and iSCSI sessions which reap the side-effects of actions took place in the context of a separate iSCSI session, while being third parties to the action that caused the side-effects. One example of a Third-party session is an iSCSI session hosting an I_T_L nexus to an LU that is reset with an LU Reset TMF via a separate I_T nexus.

1.2 Acronyms

Acronym	Definition
EDTL	Expected Data Transfer Length
IANA	Internet Assigned Numbers Authority
IETF	Internet Engineering Task Force
I/O	Input - Output
IP	Internet Protocol
iSCSI	Internet SCSI
iSER	iSCSI Extensions for RDMA

ITT	Initiator Task Tag
LO	Leading Only
LU	Logical Unit
LUN	Logical Unit Number
PDU	Protocol Data Unit
RDMA	Remote Direct Memory Access
R2T	Ready To Transfer
R2TSN	Ready To Transfer Sequence Number
RFC	Request For Comments
SAM	SCSI Architecture Model
SCSI	Small Computer Systems Interface
SN	Sequence Number
SNACK	Selective Negative Acknowledgment - also Sequence Number Acknowledgement for data
TCP	Transmission Control Protocol
TMF	Task Management Function
TTT	Target Transfer Tag
UA	Unit Attention

2 Introduction

Several iSCSI implementations had been built after [RFC3720] was published and the iSCSI community is now richer by the resulting implementation expertise. The goal of this document is to leverage this expertise both to offer clarifications to the [RFC3720] semantics and to address defects in [RFC3720] as appropriate. This document intends to offer critical guidance to implementers with regard to non-obvious iSCSI implementation aspects so as to improve interoperability and accelerate iSCSI adoption. This document, however, does not purport to be an all-encompassing iSCSI how-to guide for implementers, nor a complete revision of [RFC3720]. This document instead is intended as a companion document to [RFC3720] for the iSCSI implementers.

iSCSI implementers are required to reference [RFC3722] and [RFC3723] in addition to [RFC3720] for mandatory requirements. In addition, [RFC3721] also contains useful information for iSCSI implementers. The text in this document, however, updates and supersedes the text in all the noted RFCs whenever there is such a question.

3 iSCSI semantics for SCSI tasks

3.1 Residual handling

Section 10.4.1 of [RFC3720] defines the notion of "residuals" and specifies how the residual information should be encoded into the SCSI Response PDU in Counts and Flags fields. Section **3.1.1 clarifies the intent of [RFC3720] and explains the general** principles. Section 3.1.2 describes the residual handling in the REPORT LUNS scenario.

3.1.1 Overview

SCSI-Presented Data Transfer Length (SPDTL) is the term this document uses (see section 1.1 for definition) to represent the aggregate data length that the target SCSI layer attempts to transfer using the local iSCSI layer for a task. Expected Data Transfer Length (EDTL) is the iSCSI term that represents the length of data that iSCSI layer expects to transfer for a task. EDTL is specified in the SCSI Command PDU.

When SPDTL = EDTL for a task, the target iSCSI layer completes the task with no residuals. Whenever SPDTL differs from EDTL for a task, that task is said to have a residual.

If SPDTL > EDTL for a task, iSCSI Overflow MUST be signaled in the SCSI Response PDU as specified in [RFC3720]. Residual Count MUST be set to the numerical value of (SPDTL EDTL).

If SPDTL < EDTL for a task, iSCSI Underflow MUST be signaled in the SCSI Response PDU as specified in [RFC3720]. Residual Count MUST be set to the numerical value of (EDTL SPDTL).

Note that the Overflow and Underflow scenarios are independent of Data-in and Data-out. Either scenario is logically possible in either direction of data transfer.

3.1.2 SCSI REPORT LUNS and Residual Overflow

The specification of the SCSI REPORT LUNS command requires that the SCSI target limit the amount of data transferred to a maximum size (ALLOCATION LENGTH) provided by the initiator in the REPORT LUNS CDB. If the Expected Data Transfer Length (EDTL) in the iSCSI header of the SCSI Command PDU for a REPORT LUNS command is set to at least as large as that ALLOCATION LENGTH, the SCSI layer truncation prevents an iSCSI Residual Overflow from occurring. A SCSI initiator can detect that such truncation has occurred via other information at the SCSI layer. The rest of the section elaborates this required behavior.

iSCSI uses the (O) bit (bit 5) in the Flags field of the SCSI Response and the last SCSI Data-In PDUs to indicate that that an iSCSI target was unable to transfer all of the SCSI data for a command to the initiator because the amount of data to be transferred exceeded the EDTL in the corresponding SCSI Command PDU (see Section 10.4.1 of [RFC3720]).

The SCSI REPORT LUNS command requests a target SCSI layer to return a logical unit inventory (LUN list) to the initiator SCSI layer (see section 6.21 of SPC-3 [SPC3]). The size of this LUN list may not be known to the initiator SCSI layer when it issues the REPORT LUNS command; to avoid transfer of more LUN list data than the initiator is prepared for, the REPORT LUNS CDB contains an ALLOCATION LENGTH field to specify the maximum amount of data to be transferred to the initiator for this command. If the initiator SCSI layer has under-estimated the number of logical units at the target, it is possible that the complete logical unit inventory does not fit in the specified ALLOCATION LENGTH. In this situation, section 4.3.3.6 in [SPC3] requires that the target SCSI layer "shall terminate transfers to the Data-In Buffer" when the number of bytes specified by the ALLOCATION LENGTH field have been transferred.

Therefore, in response to a REPORT LUNS command, the SCSI layer at the target presents at most ALLOCATION LENGTH bytes of data (logical unit inventory) to iSCSI for transfer to the initiator. For a REPORT LUNS command, if the iSCSI EDTL is at least as large as the ALLOCATION LENGTH, the SCSI truncation ensures that the EDTL will accommodate all of the data to be transferred. If all of the logical unit inventory data presented to the iSCSI layer i.e. the data remaining after any SCSI truncation - is

transferred to the initiator by the iSCSI layer, an iSCSI Residual Overflow has not occurred and the iSCSI (O) bit MUST NOT be set in the SCSI Response or final SCSI Data-Out PDU. This is not a new requirement but is already required by the combination of [RFC 3720] with the specification of the REPORT LUNS command in [SPC3]. If the iSCSI EDTL is larger than the ALLOCATION LENGTH however in this scenario, note that the iSCSI Underflow MUST be signaled in the SCSI Response PDU. An iSCSI Underflow MUST also be signaled when the iSCSI EDTL is equal to ALLOCATION LENGTH but the logical unit inventory data presented to the iSCSI layer is smaller than ALLOCATION LENGTH.

The LUN LIST LENGTH field in the logical unit inventory (first field in the inventory) is not affected by truncation of the inventory to fit in ALLOCATION LENGTH; this enables a SCSI initiator to determine that the received inventory is incomplete by noticing that the LUN LIST LENGTH in the inventory is larger than the ALLOCATION LENGTH that was sent in the REPORT LUNS CDB. A common initiator behavior in this situation is to re-issue the REPORT LUNS command with a larger ALLOCATION LENGTH.

3.2 R2T Ordering

Section 10.8 in [RFC3720] says the following:

> The target may send several R2T PDUs. It, therefore, can have a number of pending data transfers. The number of outstanding R2T PDUs are limited by the value of the negotiated key MaxOutstandingR2T. Within a connection, outstanding R2Ts MUST be fulfilled by the initiator in the order in which they were received.

The quoted [RFC3720] text was unclear on the scope of applicability either per task, or across all tasks on a connection and may be interpreted as either. This section is intended to clarify that the scope of applicability of the quoted text is a task. No R2T ordering relationship either in generation at the target or in fulfilling at the initiator across tasks is implied. I.e., outstanding R2Ts within a task MUST be fulfilled by the initiator in the order in which they were received on a connection.

3.3 SCSI Protocol Interface Model for Response Ordering

Whenever an iSCSI session is composed of multiple connections, the Response PDUs (task responses or TMF responses) originating

in the target SCSI layer are distributed onto the multiple connections by the target iSCSI layer according to iSCSI connection allegiance rules. This process generally may not preserve the ordering of the responses by the time they are delivered to the initiator SCSI layer. Since ordering is not expected across SCSI responses anyway, this approach works fine in the general case. However to address the special cases where some ordering is desired by the SCSI layer, the following SCSI protocol interface model is assumed.

3.3.1 Model Description

SCSI protocol layer instructs the SCSI transport layer of a "Response Fence" associated with the response in question when the "Send Command Complete" protocol data service (SAM-2, clause 5.4.2) and "Task Management Function Executed" (SAM-2, clause 6.9) service are invoked. The Response Fence flag instructs the SCSI transport layer that the following conditions must be met in delivering the response message:

(1) Response with Response Fence MUST chronologically be delivered after all the "preceding" responses on the I_T_L nexus, if the preceding responses are delivered at all, to the application client on the initiator.

(2) Response with Response Fence MUST chronologically be delivered prior to all the "following" responses on the I_T_L nexus.

The "preceding" and "following" notions refer to the order of hand-off of a response message from the target SCSI protocol layer to the target SCSI transport (e.g. iSCSI) layer.

3.3.2 iSCSI Semantics with the Interface Model

The target iSCSI layer MUST do the following on sensing the "Response Fence" flag associated with a response being handed down from the target SCSI layer:

a) If it is a single-connection session, no special processing is required. Standard SCSI Response PDU build process happens.

b) If it is a multi-connection session, target iSCSI layer takes note of last-sent and unacknowledged StatSN on each of the connections in the iSCSI session, and waits for acknowledgement (may solicit for acknowledgement by way of a Nop-In) of each such StatSN to clear the fence. SCSI response with the Response Fence flag must be sent to the

initiator only after receiving acknowledgements for each of the unacknowledged StatSNs.

c) Target iSCSI layer must wait for an acknowledgement of the SCSI Response PDU that carried the response which the target SCSI layer marked with the Response Fence flag. The fence must be considered cleared after receiving the acknowledgement.

d) All further status processing for the LU is resumed only after clearing the fence. If any new responses for the I_T_L nexus are received from the SCSI layer before the fence is cleared, those Response PDUs must be held and queued at the iSCSI layer until the fence is cleared.

3.3.3 Current List of Fenced Response Use Cases

This section lists the fenced response use cases that iSCSI implementations must comply with. However, this is not an exhaustive enumeration. It is expected that as SCSI protocol specifications evolve, the specifications will specify when response fencing is required on a case-by-case basis.

Response Fence flag MUST be assumed set by the target SCSI layer on the following SCSI completion messages handed down to the target iSCSI layer:

1. The first completion message carrying the UA after the multi-task abort on issuing and third-party sessions.

2. The TMF Response carrying the mult-task TMF Response on the issuing session.

3. The completion message indicating ACA establishment on the issuing session.

4. The first completion message carrying the ACA ACTIVE status after ACA establishment on issuing and third-party sessions.

5. The TMF Response carrying the Clear ACA response on the issuing session.

Note: Due to the absence of ACA-related fencing requirements in [RFC3720], initiator implementations SHOULD NOT use ACA on multi-connection iSCSI sessions to targets complying only with [RFC3720], i.e. those not complying with this document. Initiators may assess target compliance to this document via negotiating for FastMultiTaskAbort (section 8.1) key.

4 Task Management

4.1 Requests Affecting Multiple Tasks

This section clarifies and updates the original text in section **10.6.2 of [RFC3720].** The clarified semantics (section 4.1.2) are a superset of the protocol behavior required in the original text and all iSCSI implementations MUST support the new behavior. The updated semantics (section 4.1.3) on the other hand are mandatory only when the new key FastMultiTaskAbort (section 8.1) is negotiated to "Yes".

4.1.1 Scope of affected tasks

This section defines the notion of "affected tasks" in multi-task abort scenarios. Scope definitions in this section apply to both the clarified protocol behavior (section 4.1.2) and the updated protocol behavior (section 4.1.3).

> ABORT TASK SET: All outstanding tasks for the I_T_L nexus identified by the LUN field in the ABORT TASK SET TMF Request PDU.
>
> CLEAR TASK SET: All outstanding tasks in the task set for the LU identified by the LUN field in the CLEAR TASK SET TMF Request PDU. See [SPC3] for the definition of a "task set".
>
> LOGICAL UNIT RESET: All outstanding tasks from all initiators for the LU identified by the LUN field in the LOGICAL UNIT RESET Request PDU.
>
> TARGET WARM RESET/TARGET COLD RESET: All outstanding tasks from all initiators across all LUs that the TMF-issuing session has access to on the SCSI target device hosting the iSCSI session.

Usage: an "ABORT TASK SET TMF Request PDU" in the preceding text is an iSCSI TMF Request PDU with the "Function" field set to "ABORT TASK SET" as defined in [RFC3720]. Similar usage is employed for other scope descriptions.

4.1.2 Clarified multi-task abort semantics

All iSCSI implementations MUST support the protocol behavior defined in this section as the default behavior. The execution of ABORT TASK SET, CLEAR TASK SET, LOGICAL UNIT RESET, TARGET WARM RESET, and TARGET COLD RESET TMF Requests consists of the following sequence of actions in the specified order on the specified party.

The initiator iSCSI layer:

a. MUST continue to respond to each TTT received for the affected tasks.

b. Should receive any responses that the target may provide for some tasks among the affected tasks (may process them as usual because they are guaranteed to have chronologically originated prior to the TMF response).

c. Should receive the TMF Response concluding all the tasks in the set of affected tasks.

The target iSCSI layer:

a. MUST wait for all currently valid target transfer tags of the affected tasks to be responded to.

b. MUST wait (concurrent with the wait in Step.a) for all commands of the affected tasks to be received based on the CmdSN ordering. SHOULD NOT wait for new commands on third-party affected sessions - only the instantiated tasks have to be considered for the purpose of determining the affected tasks. In the case of target-scoped requests (i.e. TARGET WARM RESET and TARGET COLD RESET), all the commands that are not yet received on the issuing session in the command stream however can be considered to have been received with no command waiting period - i.e. the entire CmdSN space up to the CmdSN of the task management function can be "plugged".

c. MUST propagate the TMF request to and receive the response from the target SCSI layer.

d. MUST address the Response Fence flag on the TMF Response on issuing session as defined in 3.3.2.

e. MUST address the Response Fence flag on the first post-TMF Response on third-party sessions as defined in 3.3.2. If some tasks originate from non-iSCSI I_T_L nexuses then the means by which the target ensures that all affected tasks have returned their status to the initiator are defined by the specific non-iSCSI transport protocol(s).

4.1.3 Updated multi-task abort semantics

Protocol behavior defined in this section MUST be implemented by all iSCSI implementations complying with this document. Protocol behavior defined in this section MUST be exhibited by iSCSI implementations on an iSCSI session when they negotiate the FastMultiTaskAbort (section 8.1) key to "Yes" on that session. The execution of ABORT TASK SET, CLEAR TASK SET, LOGICAL UNIT RESET, TARGET WARM RESET, and TARGET COLD RESET TMF Requests consists of the following sequence of actions in the specified order on the specified party.

The initiator iSCSI layer:

a. MUST NOT send any more Data-Out PDUs for affected tasks on the issuing connection of the issuing iSCSI session once the TMF is sent to the target.

b. Should receive any responses that the target may provide for some tasks among the affected tasks (may process them as usual because they are guaranteed to have chronologically originated prior to the TMF response).

c. MUST respond to Async Message PDU with AsyncEvent=5 as defined in section 7.1.

d. Should receive the TMF Response concluding all the tasks in the set of affected tasks.

The target iSCSI layer:

a. MUST wait for all commands of the affected tasks to be received based on the CmdSN ordering on the issuing session. SHOULD NOT wait for new commands on third-party affected sessions - only the instantiated tasks have to be considered for the purpose of determining the affected tasks. In the case of target-scoped requests (i.e. TARGET WARM RESET and TARGET COLD RESET), all the commands that are not yet received on the issuing session in the command stream however can be considered to have been received with no command waiting period - i.e. the entire CmdSN space up to the CmdSN of the task management function can be "plugged".

b. MUST propagate the TMF request to and receive the response from the target SCSI layer.

c. MUST leave all active "affected TTTs" (i.e. active TTTs associated with affected tasks) valid along with any buffer allocations for the TTTs intact.

d. MUST generate an Asynchronous Message PDU with AsyncEvent=5 (section 7.1) on:
   i) each connection of each third-party session that at least one affected task is allegiant to, and
   ii) each connection except the non-issuing connection of the issuing session that has at least one allegiant affected task.

   If there are multiple affected LUs (say due to a target reset), then one Async Message PDU MUST be sent for each such LU on each connection that has at least one allegiant affected task.

e. MUST address the Response Fence flag on the TMF Response on issuing session as defined in 3.3.2.

f. MUST address the Response Fence flag on the first post-TMF Response on third-party sessions as defined in 3.3.2. If some tasks originate from non-iSCSI I_T_L nexuses then the means by which the target ensures that all affected tasks have returned their status to the initiator are defined by the specific non-iSCSI transport protocol(s).

g. MUST free up the affected TTTs (and STags, if applicable) and the corresponding buffers once it receives the associated Nop-Out acknowledgement that the initiator generated in response to the Async Message.

Implementation note: Technically, the TMF servicing is complete in Step.e. Data transfers corresponding to terminated tasks may however still be in progress even at the end of Step.f. In the case of iSCSI/iSER, these transfers would be into tagged buffers with STags not owned by any active tasks. Step.g specifies an event to free up the resources. A target may, on an implementation-defined internal timeout, also choose to drop the connections on which it did not receive the

expected Nop-Out acknowledgements so as to reclaim the associated buffer, STag and TTT resources as appropriate.

4.1.3.1 Clearing effects update

Appendix F.1 of [RFC3720] specifies the clearing effects of target and LU resets on "Incomplete TTTs" as "Y". This meant that a target warm reset or a target cold reset or an LU reset would clear the active TTTs upon completion. The FastMultiTaskAbort semantics defined by this section however do not guarantee that the active TTTs are cleared by the end of the reset operations. In fact, the new semantics are designed to allow clearing the TTTs in a "lazy" fashion after the TMF Response is delivered. Thus, when FastMultiTaskAbort=Yes is operational on a session, the clearing effects of reset operations on "Incomplete TTTs" is "N".

4.1.4 Rationale behind the new semantics

There are fundamentally three basic objectives behind the semantics specified in section 4.1.2 and section 4.1.3.

1. Maintaining an ordered command flow I_T nexus abstraction to the target SCSI layer even with multi-connection sessions.

   - Target iSCSI processing of a TMF request must maintain the single flow illusion. Target behavior in Step.b of section 4.1.2 and Step.a of section 4.1.3 correspond to this objective.

2. Maintaining a single ordered response flow I_T nexus abstraction to the initiator SCSI layer even with multi-connection sessions when one response (i.e. TMF response) could imply the status of other unfinished tasks from the initiator's perspective.

   - Target must ensure that the initiator does not see "old" task responses (that were placed on the wire chronologically earlier than the TMF Response) after seeing the TMF response. Target behavior in Step.d of section 4.1.2 and Step.e of section 4.1.3 correspond to this objective.

   - Whenever the result of a TMF action is visible across multiple I_T_L nexuses, [SAM2] requires the SCSI device server to trigger a UA on each of the other

I_T_L nexuses. Once an initiator is notified of such an UA, the application client on the receiving initiator is required to clear its task state (clause 5.5 in [SAM2]) for the affected tasks. It would thus be inappropriate to deliver a SCSI Response for a task after the task state is cleared on the initiator, i.e. after the UA is notified. The UA notification contained in the first SCSI Response PDU on each affected Third-party I_T_L nexus after the TMF action thus MUST NOT pass the affected task responses on any of the iSCSI sessions accessing the LU. Target behavior in Step.e of section 4.1.2 and Step.f of section 4.1.3 correspond to this objective.

3. Draining all active TTTs corresponding to affected tasks in a deterministic fashion.

   o Data-out PDUs with stale TTTs arriving after the tasks are terminated can create a buffer management problem even for traditional iSCSI implementations, and is fatal for the connection for iSCSI/iSER implementations. Either the termination of affected tasks should be postponed until the TTTs are retired (as in Step.a of section 4.1.2), or the TTTs and the buffers should stay allocated beyond task termination to be deterministically freed up later (as in Step.c and Step.g of section 4.1.3).

The only other notable optimization is the plugging. If all tasks on an I_T nexus will be aborted anyway (as with a target reset), there is no need to wait to receive all commands to plug the CmdSN holes. Target iSCSI layer can simply plug all missing CmdSN slots and move on with TMF processing. The first objective (maintaining a single ordered command flow) is still met with this optimization because target SCSI layer only sees ordered commands.

5 Discovery semantics

5.1 Error Recovery for Discovery Sessions

The negotiation of the key ErrorRecoveryLevel is not required for Discovery sessions i.e. for sessions that negotiated "SessionType=Discovery" because the default value of 0 is necessary and sufficient for Discovery sessions. It is however possible that some legacy iSCSI implementations might attempt to negotiate the ErrorRecoveryLevel key on Discovery sessions. When such a negotiation attempt is made by the remote side, a compliant iSCSI implementation MUST propose a value of 0 (zero) in response. The operational ErrorRecoveryLevel for Discovery sessions thus MUST be 0. This naturally follows from the functionality constraints [RFC3720] imposes on Discovery sessions.

5.2 Reinstatement Semantics of Discovery Sessions

Discovery sessions are intended to be relatively short-lived. Initiators are not expected to establish multiple Discovery sessions to the same iSCSI Network Portal (see [RFC3720]). An initiator may use the same iSCSI Initiator Name and ISID when establishing different unique sessions with different targets and/or different portal groups. This behavior is discussed in Section 9.1.1 of [RFC3720] and is, in fact, encouraged as conservative reuse of ISIDs. ISID RULE in [RFC3720] states that there must not be more than one session with a matching 4-tuple: <InitiatorName, ISID, TargetName, TargetPortalGroupTag>. While the spirit of the ISID RULE applies to Discovery sessions the same as it does for Normal sessions, note that some Discovery sessions differ from the Normal sessions in two important aspects:

Because [RFC3720] allows a Discovery session to be established without specifying a TargetName key in the Login Request PDU (let us call such a session an "Unnamed" Discovery session), there is no Target Node context to enforce the ISID RULE.

Portal Groups are defined only in the context of a Target Node. When the TargetName key is NULL-valued (i.e. not specified), the TargetPortalGroupTag thus cannot be ascertained to enforce the ISID RULE.

The following sections describe the two scenarios Named Discovery sessions and Unnamed Discovery sessions separately.

5.2.1 Unnamed Discovery Sessions

For Unnamed Discovery sessions, neither the TargetName nor the TargetPortalGroupTag is available to the targets in order to enforce the ISID RULE. So the following rule applies.

UNNAMED ISID RULE: Targets MUST enforce the uniqueness of the following 4-tuple for Unnamed Discovery sessions: <InitiatorName, ISID, NULL, TargetAddress>. The following semantics are implied by this uniqueness requirement.

Targets SHOULD allow concurrent establishment of one Discovery session with each of its Network Portals by the same initiator port with a given iSCSI Node Name and an ISID. Each of the concurrent Discovery sessions, if established by the same initiator port to other Network Portals, MUST be treated as independent sessions i.e. one session MUST NOT reinstate the other.

A new Unnamed Discovery session that has a matching <InitiatorName, ISID, NULL, TargetAddress> to an existing discovery session MUST reinstate the existing Unnamed Discovery session. Note thus that only an Unnamed Discovery session may reinstate an Unnamed Discovery session.

5.2.2 Named Discovery Sessions

For a Named Discovery session, the TargetName key is specified by the initiator and thus the target can unambiguously ascertain the TargetPortalGroupTag as well. Since all the four elements of the 4-tuple are known, the ISID RULE MUST be enforced by targets with no changes from [RFC3720] semantics. A new session with a matching <InitiatorName, ISID, TargetName, TargetPortalGroupTag> thus will reinstate an existing session. Note in this case that any new iSCSI session (Discovery or Normal) with the matching 4-tuple may reinstate an existing Named Discovery iSCSI session.

5.3 TPGT Values

SAM-2 and SAM-3 specifications incorrectly note in their informative text that TPGT value should be non-zero, although [RFC3720} allows the value of zero for TPGT. This section is to clarify that zero value is expressly allowed as a legal value for TPGT. A future revision of SAM will be corrected to address this discrepancy.

5.4 Session type negotiation

During the Login phase, the SessionType key is offered by the initiator to choose the type of session it wants to create with the target. The target may accept or reject the offer. Depending on the type of the session, a target may decide on resources to allocate and the security to enforce etc. for the session. If the SessionType key is thus going to be offered as "Discovery", it SHOULD be offered in the initial Login request by the initiator.

6 iSCSI Error Handling and Recovery

6.1 ITT

Section 10.19 in [RFC3720] mentions this in passing but noted here again for making it obvious since the semantics apply to the initiators in general. An ITT value of 0xffffffff is reserved and MUST NOT be assigned for a task by the initiator. The only instance it may be seen on the wire is in a target-initiated NOP-In PDU (and in the initiator response to that PDU if necessary).

6.2 Format Errors

Section 6.6 of [RFC3720] discusses format error handling. This section elaborates on the "inconsistent" PDU field contents noted in [RFC3720].

All initiator-detected PDU construction errors MUST be considered as format errors. Some examples of such errors are:

- NOP-In with a valid TTT but an invalid LUN

- NOP-In with a valid ITT (i.e. a NOP-In response) and also a valid TTT

- SCSI Response PDU with Status=CHECK CONDITION, but DataSegmentLength = 0

6.3 Digest Errors

Section 6.7 of [RFC3720] discusses digest error handling. It states that "No further action is necessary for initiators if the discarded PDU is an unsolicited PDU (e.g., Async, Reject)" on detecting a payload digest error. This is incorrect.

An Asynchronous Message PDU or a Reject PDU carries the next StatSN value on an iSCSI connection, advancing the StatSN. When an initiator discards one of these PDUs due to a payload digest error, the entire PDU including the header MUST be discarded. Consequently, the initiator MUST treat the exception like a loss of any other solicited response PDU i.e. it MUST use one of the following options noted in [RFC3720]:

a) Request PDU retransmission with a status SNACK.

b) Logout the connection for recovery and continue the tasks on a different connection instance.

c) Logout to close the connection (abort all the commands associated with the connection).

7 iSCSI PDUs

7.1 Asynchronous Message

This section defines additional semantics for the Asynchronous Message PDU defined in section 10.9 of [RFC3720] using the same conventions.

The following new legal value for AsyncEvent is defined:

5: all active tasks for LU with matching LUN field in the Async Message PDU are being terminated.

The receiving initiator iSCSI layer MUST respond this Message by taking the following steps in order.

i) Stop Data-Out transfers on that connection for all active TTTs for the affected LUN quoted in the Async Message PDU.
ii) Acknowledge the StatSN of the Async Message PDU via a Nop-Out PDU with ITT=0xffffffff (i.e. non-ping flavor), while copying the LUN field from Async Message to Nop-Out.

8 Login/Text Operational Text Keys

This section follows the same conventions as section 12 of [RFC3720].

8.1 FastMultiTaskAbort

Use: LO
Senders: Initiator and Target
Scope: SW

Irrelevant when: SessionType=Discovery
FastMultiTaskAbort=<boolean-value>

Default is No.
Result function is AND.

This key is used to negotiate the updated fast multi-task abort semantics defined in section 4.1.3. By negotiating this key to "Yes", an initiator and a target agree that the new semantics MUST be used in the multi-task TMF handling situations. The default is to use the [RFC3720] TMF semantics as clarified in section 4.1.2.

9 Security Considerations

This document does not introduce any new security considerations other than those already noted in [RFC3720]. Consequently, all the iSCSI-related security text in [RFC3723] is also directly applicable to this document.

10 IANA Considerations

This draft does not have any specific IANA considerations other than those already noted in [RFC3720].

11 References and Bibliography

11.1 Normative References

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11.2 Informative References

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14 Full Copyright Statement

15 Intellectual Property Statement

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